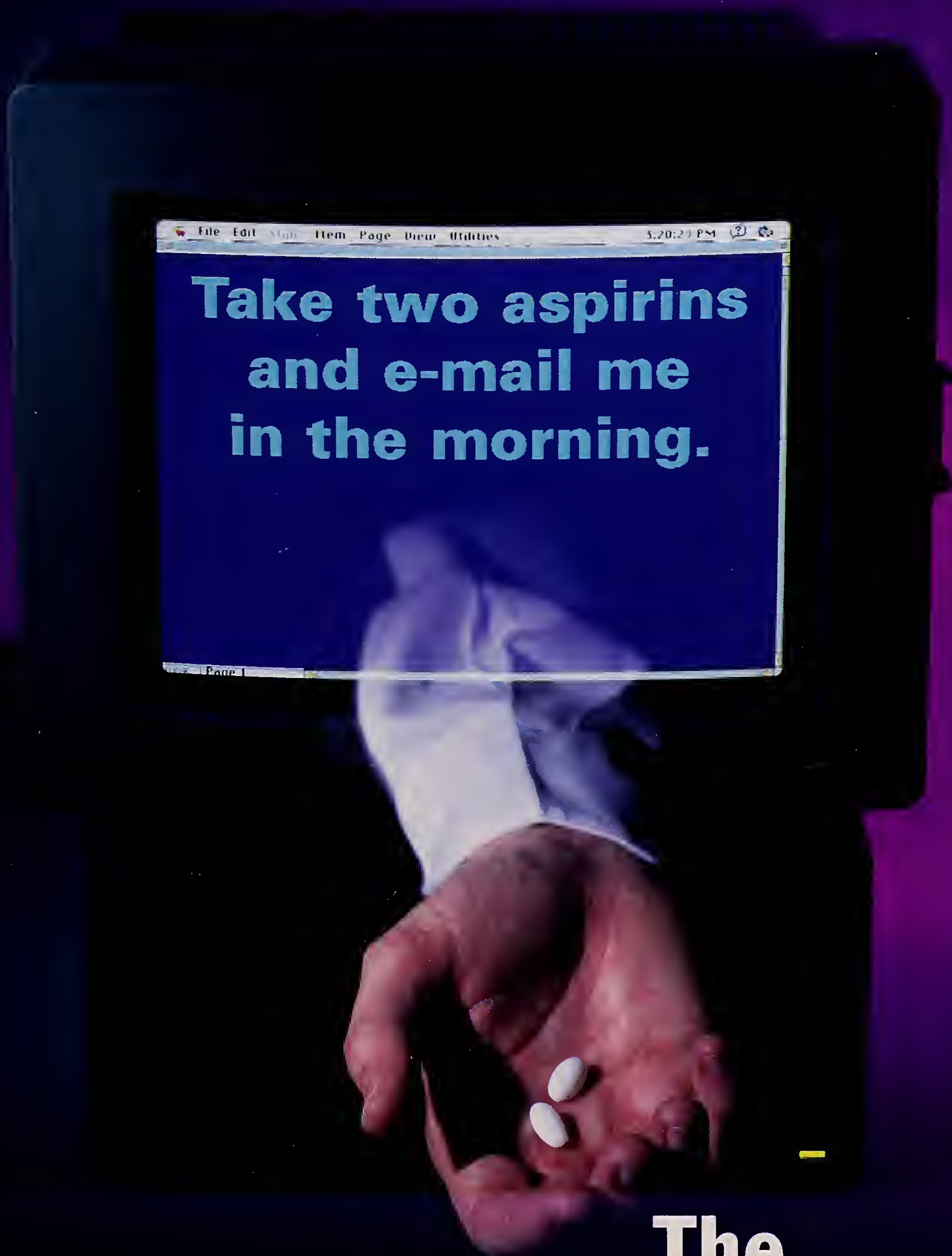
Harvard Medical

ALUMNI BULLETIN

SPRING 1996



The Virtual Physician

Spring 1996
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Cover photo by Stuart Darsch

Inside HMAB

In the last year or so, several of my patients have said something like the following: "I read about those drugs on the Web, and I really don't want to take one of them" or "Do you think I should take X? I read about it on the Web." Thus, what only recently seemed futuristic to me is starting to look very much like the present. I don't suppose the essays in this edition of the *Bulletin* will be out of date by the time this issue reaches you, but I confess they seem less visionary than when we first started reading the manuscripts.

As Robert Greenes contends, information is becoming radically less centralized in the new world of the Internet. In many ways, this will doubtless be a Good Thing, though from time to time, it may also be problematic. To pursue my humble example, most physicians are accustomed to having patients come in with information from a current best-seller (in my case, *Listening to Prozac* or *Driven to Distraction*). It is quite a different experience when this information comes from a community of patients describing their experience on the Web.

There can be little doubt that the Web will increasingly "democratize" medical information. Jerome Kassirer, editor of *The New England Journal of Medicine*, sketches a view of how this might work, and of how medical care may overcome certain limitations of space and time through the burgeoning capacity of computer and network systems.

Other contributors to this issue of *HMAB* describe various ways in which new computer technology is changing the reach of our knowledge and understanding. For most, this takes the form of a dramatic enhancement of intellectual resources or mental capacity. (I offer a minor autobiographical exception to this trend.)

With this issue of *HMAB* we must say goodbye to Associate Editor Terri L. Rutter. We have greatly benefited from her prose, passion, vision and humor. Ms. Rutter has led us into the mysteries of the Internet, and she was the moving spirit behind the issue celebrating 50 years of women at HMS. Both in signed articles and in tactful editing she has helped to shape this magazine. We thank her and wish her all the best as she moves into the next phase of her writing career.

William Ira Bennett '68

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Letters

Obstructed View

The articles on the topic of HMOs and so called managed care (Winter '96) were timely and very interesting; however, some pages were very trying to read. Pages printed on a gray background of varying density were difficult to see clearly, especially under artificial light. And lastly, "Changes in the Amphitheatre" in three divided columns on each page added to the frustrations of trying to read my favorite alumni magazine. We older alums have trouble enough with our sight.

Are we trying too hard to be trendy?

Albert P. Ley '43B

Grammatical Error

A sentence in the recent issue (Winter '96, p56) reminds me of the old *New Yorker* quips: "Clement was a psychiatrist who specialized in the treatment of alcoholism on the staff of Buffalo General Hospital."

Buffalo is a tough place to live but...

Eugene E. Nattie '71

Creative Support

I was very interested in your column in the Winter '96 *Bulletin* announcing the arrival of Cushing Robinson to superintend the development campaign for HMS. I was heartened that HMS had chosen someone with experience with the University of Pennsylvania Medical School's effort to realize what you sarcastically refer to as the "pipe dream" ['a fantastic notion or vain hope....from the fantasies induced by smoking opium'] of a tuition-free medical education for all students."

There was insufficient detail to ascertain whether Robinson's $10 million allocation at Penn was enough to generate the full tuition equivalent for 24 students, or whether it was merely the seed money for a larger sum. In any case, I remain confused by your assumption that $500 million would be required to render HMS tuition-free.

Assuming that in today's market HMS could obtain a (tax-free) return on investment of at least 10 percent, 5 percent would generate $25 million, enough to more than equal the annual tuition bills of 1,000 students (HMS has less than 700). I do not mean to belittle the task of raising such a sum; but by making it unnecessarily large, you inhibit any serious discussion of generating funds for such a purpose. However, when the total cost of supporting a student for one year at HMS approaches the annual income of the average American family, novel solutions must be sought and tested with real urgency.

It is ironic that in the same issue of the *Bulletin*, the Alumni Council is described as searching for "creative ways to deal with financial issues," without any reference to the UPenn (or any other) initiative. Further, HMS announces its pride in generating fellowships for junior faculty who, more than likely, need the income to help pay off their student loans!

Instead of repetitive solicitations of money from alumni/ae to help the neediest students from drowning in debt while forcing more affluent families to subsidize tuition for those unable to pay, shouldn't HMS allocate vigorous development effort to obtaining hard money for a permanent endowment to defray tuition?

In an era of declining income expectations for physicians (and increasing physician/physician marriage), what is Harvard teaching its students when it encourages them to aggravate their individual indebtedness by more than $100,000, or forces them to turn to their parents to scavenge money from retirement funds or sib-

lings' inheritances? Mixed with the joy of becoming a doctor will be the bitterness of prolonged financial hardship.

If creative thinking or new initiatives—as well as funds—are wanting, I and other HMS graduates will always be eager to help. But I think that perennially dunning us to offset tuition is merely a stopgap measure. It has no more grace, and far less moral weight, than assisting the homeless. It is time to reconsider our priorities so that they reflect a leadership role for Harvard with regard to the support, as well as the content, of medical education.

Mark G. Perlroth '60

Too Much Change

I have put off this note (along with my reduced yearly donation), because it gives me great pain to compose this. While attending my 60th college reunion, I thought I would revisit Vanderbilt and see how things were going. It was like my walking into some East Asian school—no responses to my greetings and much jabbering in foreign tongues.

Then came the "Making Herstory" issue (Spring '95) and the cover photo awakened me (very sadly) as to what was going on at Alma Mater. I am not prejudiced against women as doctors, but the takeover of the school by affirmative action women students I cannot stand.

Something is very amiss among those who guide the admissions policy of Harvard Medical School, and it is high time for a reversal of this trend.

I had given a moderate sum to the school in my will, but I have had my lawyer delete this. I will not support this conversion. This upsets me very much, but if this is disloyalty, so be it.

Wm. Neil Campbell Jr. '38

Pulse

A Boost for Geriatric Medicine

The geriatric education center, part of the Harvard Medical School Division on Aging, is developing a model education program that will broaden the scope of geriatric care. The program will train advanced-degree students in an interdisciplinary approach to geriatrics, including primary care skills. Since 60 percent of all health care users are older than 65, almost every health care provider sees elderly patients and, according to Sue Levkoff, director of the Harvard Upper New England Geriatric Education Center, physicians need to pay more attention to giving this population adequate and well-rounded care.

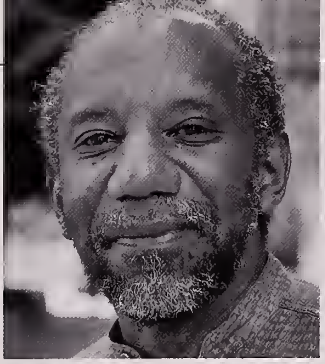
"The care of the older person demands this interdisciplinary perspective because of complex health care needs that are exacerbated by social determinants and outcomes as well as environmental issues," says Levkoff.

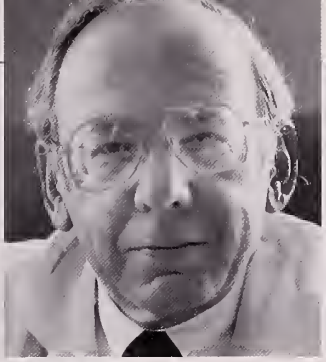
A $100,000 training grant from the John A. Hartford Foundation in New York will assist the school in the development of the education program. Levkoff, associate professor in social medicine, and Barbara Berkman, associate director of the geriatric education center and director of social work research at MGH, will coordinate the program's planning process.

Under the grant, the geriatric education center is working with academic and clinical faculty within Harvard and at other educational institutions in the Boston area to develop and initiate four products: a clinical teaching pathway, an interdisciplinary curriculum for providing geriatric care in the clinical setting, interdisciplinary communication tools, and a model for teaching patients and family members to participate in planning their own care. Ethical issues of geriatric primary care will be emphasized in all aspects of this education model.

Barbara Berkman (left) and Sue Levkoff

photo by Philip Farnsworth


Felton Earls


Robert Glickman


Ferenc Jolesz


David Livingston

Institute Honors

The Institute of Medicine of the National Academy of Sciences has appointed three new members from Harvard Medical School: Felton Earls, HMS professor of child psychiatry and HSPH assistant professor of human behavior and development; Robert Glickman, Herrman Ludwig Blumgart Professor of Medicine at HMS and chairman of the Department of Medicine at Beth Israel Hospital; and Ferenc Jolesz, HMS associate professor of radiology and director of the Division of Magnetic Resonance Imaging at Brigham and Women's Hospital. David Livingston, Emil Frei Professor of Medicine at HMS and chair of the research executive committee at the Dana-Farber Cancer Institute, has been named to the National Academy of Sciences.

Earls has been studying how such factors as poverty, social devaluation, physical and emotional abuse, and the breakdown of neighborhood communities can put children at risk for mental and emotional disorders. He is the scientific director of the Project on Human Development in Chicago Neighborhoods, a long-term study of 9,000 children and their families.

Glickman has studied the metabolism and absorption of fats and lipoproteins for more than two decades. Glickman and colleagues discovered that the small intestine produces apoproteins that coat the various fat molecules as they travel in the bloodstream. His work has helped reveal how fat molecules make their way into the bloodstream from the diet, and underscores the important role of the intestine in lipoprotein metabolism.

Jolesz has advanced imaging techniques used in neuroradiology to guide various surgical interventions. Recently, he spurred the development of an innovative magnetic-resonance operating environment that provides surgeons with real-time images of tissues deep inside the brain and other organs. (See story page 32.)

Livingston studies the DNA tumor virus SV40 and how it promotes the cancerous growth of mammalian cells. Livingston's group has also isolated and started defining the function of a family of proteins that contribute to the growth of mammalian cells; his laboratory is part of an international effort to decipher the basic biochemical mechanisms that the Rb protein uses to maintain normal cell behavior.

The Second-Year Show expressed fears of debt in dance and song:

When the Newt is in the Senate House
And HMOs are on the rise
MBAs will mold health care
And welfare's swift demise.

This is the dawning of the Age of Indebtedness.

photo by Philip Farnsworth

Judith Palfrey and T. Berry Brazelton

Dean Daniel Tosteson is flanked by Fritz Bach (left) and Anthony Monaco.

Three New Professorships Filled

With the finale of 1995 came the celebration of three new professorships and the selection of their first incumbents. November was a busy month in the faculty room, first feting two professors in transplantation surgery, Fritz H. Bach '60 as the Lewis Thomas Professor of Surgery and Anthony P. Monaco '56 as the Peter Medawar Professor of Surgery, both endowed by the Sandoz Pharmaceutical Corporation. Then a week later, Judith Palfrey, chief of the Children's Hospital division of general pediatrics, was saluted as the T. Berry Brazelton Professor of Pediatrics.

Bach, who is director of the Sandoz Center of Immunobiology at the New England Deaconess Hospital, did his internship and medical residency at New York University, where he said, "Lewis Thomas became my friend and mentor, who inspired by example by providing wisdom and encouragement." In 1964, under Thomas's guidance, Bach developed the mixed lymphocyte culture as a test for tissue compatibility for transplantation, an assay that is still used for tissue typing. Though famous for his poetic essays, Thomas '37, who died in 1993, was renowned also as a medical scientist who wrote prolifically on a variety of interests, many concerned with the host response to infection.

The other professorship in surgery is named for Peter Medawar, a pioneer of transplantation science and Nobel laureate for his discoveries about rejection and "privileged" times for transplantation. Though a zoologist, "Peter Medawar was driven in his research to help people solve clinical problems," said Monaco, in his tribute to the man whose name he will carry on his professorship. Monaco did not personally know Medawar, who died in 1987, but he said that he has pursued Medawar's line of inquiry into tissue transplantation and its therapeutic applications for more than 30 years. Monaco is chief of organ transplantation at the Deaconess.

T. Berry Brazelton is a household name for those who have children, and his name will now grace the third new professorship. Renowned for his work in child development and for creating the neonatal behavioral assessment scale, Brazelton has written 26 books and more than 180 scientific articles and chapters. He was chief of Children's Hospital's child development unit from 1972 to 1989 and is professor of pediatrics emeritus.

Judith Palfrey is a pediatrician who has devoted her professional career to improving community health care services for children. She recently published the book *Community Child Health: An Action Plan for Today.*

"To be associated with T. Berry Brazelton's name has got to be the greatest honor," said Palfrey. "This is an opportunity for us to listen and to put the child back in the center, back in the family, back in the community."

HST Silver Jubilee

The Harvard-MIT Division of Health Sciences and Technology (HST) welcomed back 43 graduates for a 25th anniversary celebration December 7 and 8, 1995. The HST Silver Jubilee honored the division's founders, showcased the achievements of its alumni, and anticipated the future of the division through discussion of its educational and research activities.

HST is an interdisciplinary collaborative effort of HMS and MIT established in 1970 to focus science and technology on human health problems. "In 1970 combining science and engineering with compassion and care for patients was an untried idea," said Irving London '39, the founding director of HST for 15 years and a professor emeritus at both HMS and MIT. "We had to integrate two universities with different strengths and decidedly different cultures."

HST students opt among programs that lead to an MD, a combined MD/PhD or just a PhD. In the history of the program there have been 500 graduates who received MDs (some of whom also earned PhDs) and about 70 who got a PhD alone. HST is one of the five academic societies at HMS, although for the first two preclinical years, HST students attend separate courses, at both MIT and HMS. They then join the rest of the medical students on the wards for clerkships.

The intent of the HST curriculum is to "educate leaders in academic medicine and the biomedical sciences" and to impart a "quantitative and molecular understanding of pathophysiologic processes." As summarized in a previous course catalog: "Graduates appreciate the relevance of fluid mechanics

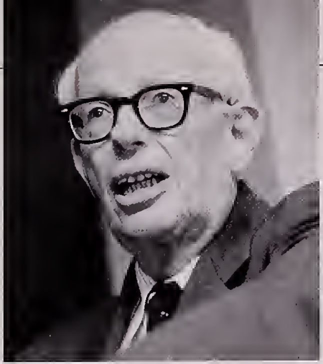


photo by J. Berndt

Walter Abelman

photo by J. Berndt

Irving London

photo by Philip Farnsworth

and mathematical modeling to the understanding of cardiovascular pathophysiology; they are exposed to the potential contributions of artificial intelligence and robotics to the understanding of the human nervous system; and they are able to integrate the concepts of molecular biology and biochemistry into their care of patients."

The HST celebration commenced with a reception and dinner at the Museum of Science, featuring speeches by London and Walter H. Abelmann, a former HST director and HMS professor of medicine emeritus. A full day of scientific presentations by 15 HST alumni followed on Friday, culminating in the silver jubilee dinner at the MIT Faculty Club, at which those who played a major role in HST's history were honored: London, Abelmann, the late Robert Ebert, former dean of HMS, Richard Kitz, a former director of the HST program, and Walter Rosenblith, MIT professor emeritus.

A dedicated few stayed on Saturday morning, as it began to snow, where over breakfast they discussed the future of the division. Michael Rosenblatt '73 and Roger Mark '65, who are now co-directors of the division, and Associate Director Joseph Bonventre '76 led the discussion. They talked about the most recently established programs—a doctoral program in speech and the hearing sciences; and the Radiological Sciences Joint Program—and asked for input on the direction of the division in face of changes in the health care field. Whatever happens, new initiatives are being planned and, as Rosenblatt noted, "We're looking forward to our golden jubilee."

From Here to Japan

In June of last year, six students from Harvard Medical School served as ambassadors of the New Pathway to the University of Tokyo. For five days the HMS students were paired with eight Japanese medical students, sharing sometimes vastly differing perspectives on everything from medical education and patient care to food and birds. (One Japanese student commented that he had never realized before there was a difference between a dirty pigeon and a peaceful dove—they're the same species in Japanese—and why Americans would order sushi without the fish.) In October 1995 the Japanese students visited HMS to witness medicine the American way.

Under the faculty advisorship of Robert Fletcher '66, professor of ambulatory care and prevention, and Richard Heller, professor of community medicine at the University of Newcastle Faculty of Medicine and Health Sciences in Australia, HMS students demonstrated the New Pathway-style of case-based, small-group instruction by discussing cases used in second-year tutorials. It was quite a learning experience for both groups, as one Japanese student said in his evaulation of the program: "The American students ask many questions and actively express their own opinions." This behavior is in marked contrast to how another student described his experiences in medical school: "We are apt to be passive and sleepy in the Japanese type of lecture."

The students also planned a joint project whereby they examined the entire regimen of care for a patient with colorectal cancer, from discussions about how to prevent the condition to the death of the afflicted patient. Again, the differences between the two systems of health care delivery were profound. In Japan, patients with cancer are frequently not told they have a terminal illness, and many students commented on how sharply that view contrasted with the perspective in this country, where the patient is told everything.

The exchange program was the brainchild of Kiyoshi Kurokawa, professor of medicine and director of international academic affairs at the Univeristy of Tokyo. Kurokawa taught medicine in the United States for 14 years before returning to Japan in 1983. Since then, he has been interested in initiating exchange programs between the United States and Japan so practitioners and students from each can gain understanding about the similarities and differences between the two countries. He had a particular desire to know more about HMS's New Pathway and thus, when a wealthy Japanese entrepreneur offered to fund the entire project with a grant from his company, the idea took flight.

"We both taught each other equally, and we both had to learn to adapt to the other's ways," says Keri Gardner '96 in a booklet the Japanese students put together describing their experiences. "While it required much work, and much frustration, we did and for that I think we are all proud."

Whether the project continues depends on continued funding.

Stephen Burakoff, professor of pediatrics at Dana-Farber Cancer Institute, was awarded the first Excellence in Mentoring Award by William Silen, dean for faculty development and diversity.

Burakoff was chosen following a canvasing of faculty and students, which garnered over 500 nominations for 247 faculty. In announcing the award to the Faculty Council, Silen read from a collection of comments made by faculty and students about Burakoff, including the following:

"His ability to support diverse individuals in their careers, to help them through the confusing and often unsupportive environment in which we find ourselves, and to give generously of his own time and visibility for our benefit all make him an outstanding candidate for this award."

Managing Care for Drug Abuse

The Harvard Medical School has joined forces with Brandeis University to study how drug and alcohol abuse and addiction are treated under managed care. The project will link HMS's Department of Health Care Policy with the Institute for Health Policy at the Heller Graduate School for Advanced Studies in Social Welfare at Brandeis. Richard Frank, HMS professor of health economics, will co-direct the new effort, called the Brandeis/Harvard Research Center for Managed Care and Drug Abuse Treatment, with Dennis McCarty, professor at Brandeis. The National Institute on Drug Abuse has granted the new center $4.5 million.

Alcoholism and other forms of substance abuse are chronic diseases requiring a commitment to long-term care, yet managed care programs are geared toward more acute care among a relatively stable patient population. With more and more people signing on to HMOs and the like, however, managed care plans will increasingly assume more responsibility for treating drug and alcohol abuse and addiction. The center hopes to provide some analyses about how that can best be achieved.

"No one is quite sure about what methods lead to what effects," says Frank. "There's enough good experience to give people a sense that it can be done right, but enough bad that there's concern."

McCarty says he would like managed care providers to ask how they can better care for their patients with substance abuse—"questions that managed care organizations ask about all the care they provide." He also believes, he says, that substance abuse treatment centers funded by the public sector need to be more active in reaching out to managed care organizations to find ways they can work together. These treatment centers, which have considerable experience treating the unique problems of the noninsured or underinsured, become increasingly valuable as managed care organizations reach out to Medicaid patients.

The center has embarked on three investigations, which will analyze data from 20 states in total:

- tracking the development of "carve-out" arrangements, whereby funds for mental health services, including substance abuse care, are delineated or carved out from the rest of the plan. The center will determine how Medicaid and privately insured groups handle this payment method in their delivery of substance abuse services;
- empirical studies on the financial incentives in contracts between purchasers and managed care organizations and their effects on the costs and utilization of treatment services;
- and measuring provider practice and performance by identifying treatment programs and measuring their effectiveness by the severity of conditions being treated.

"The center will not only increase understanding of the substance abuse treatment system, it will identify the effects of managed care and improve the ability of policy makers and those who provide treatment to achieve the most appropriate and efficient care," says McCarty.

Center Open for Minimally Invasive Surgery

Four years ago Arthur Lage, HMS associate professor of surgery, invited surgical staff from the school's five affiliated hospitals to come together and discuss whether there was any interest in establishing a center for the research and practice of minimally invasive surgery. His idea was received with "a great amount of interest," and so he formed a working group to organize and search for a funding source for this venture. U.S. Surgical Corp., maker of laparoscopic surgical instruments, answered the call and on December 6, 1995 the Harvard Center for Minimally Invasive Surgery opened.

"This center is unique in that it's the largest and best designed as well as having the most ambitious program," of any of its kind in the country, boasts Lage.

Laparoscopic surgery is performed with a miniature camera, which is inserted through a small incision. Guided by the images relayed from the camera as it searches its way through the body cavity—images that are then transferred onto an overhead display terminal—the surgeon is able to scope the afflicted part. Because there is no large opening of the body cavity, recovery time is usually much shorter than following traditional surgery.

Currently, laparoscopic techniques are used successfully in five major areas: urology, ob/gyn, gastroenterology, general surgery and thoracic surgery. Lage hopes that research done at the center will lead to uses in other areas, as well as improvements in technique and also in the technology itself. Among the most recent advances he points to are the uses of minimally invasive procedures while the patient is undergoing MRI.

"The latest laparoscopic cameras have a high resolution and the surgical equipment is becoming more miniaturized," says Lage.

Located in 3,400 sq. ft. in the Seeley G. Mudd Building, the center allows for the centralization of the research and training of minimally invasive surgery for the first time. Before the center opened, each surgical department had its own program, explains Lage. Centralized training standardizes and improves the learning experience for residents. The center also offers CME courses for practicing physicians.

The center is outfitted with a surgical suite, physiology laboratory, animal housing and an x-ray room. It also uses inanimate pelvic trainers and rubber torsos, equipped with realistic organs, with which residents and learning practitioners practice maneuvering the laparoscopic equipment.

Howard Hughes Grant Awarded

The Howard Hughes Medical Institute, the nation's largest private philanthropy, has awarded Harvard Medical School a $2.2 million grant, part of $80 million the institute is granting to schools around the country. The money will support research at the interface of neurobiology and cell biology, "two of the most exciting areas in modern biomedical science," said Dean Daniel Tosteon '49.

Gerald Fishbach, Nathan March Pusey Professor of Neurobiology, and Marc Kirschner, the Carl W. Walter Professor of Cell Biology, are working together on a joint program to recruit scientists, establish shared research facilities, and develop collaborative research programs.

Arthur Lage (left)at the opening of the Center for Minimally Invasive Surgery with Carlos Labini and Leon Hirsch from U.S. Surgical and Cynthia Barlow, center coordinator.

photo by Steve Gilbert

President's Report

by Stephanie H. Pincus

The snows had melted and floods abated by the time of the winter meeting of the Harvard Medical Alumni Council on Friday, January 26, 1996. Like all academic medical centers, Harvard is struggling with the issue of managed care and its implications for medical education. Questions raised include:

- Should managed care principles be taught in the curriculum?
- How should evaluation of patients be modified in keeping with the time management principles of managed care?
- Should medical education be changed to include more population-based medicine?
- How should the curriculum be adapted or revised in order to meet the new expectations for physician practice?
- What should medical students be taught about the role of allied health professionals, such as physician assistants and nurse practitioners?

These questions stimulated lively discussion but no resolution. The comments and perceptions of the Alumni Council will be included, however, in upcoming discussions at the medical school. The council had the opportunity to hear two recent graduates, Glen Churtow '89 and Mark Hughes '86, bring insights from the local Boston area. Keep posted for further news on this stimulating and challenging topic.

Applications for first-year places at Harvard Medical School continue to climb upwards, with over 4,000 applicants for the class entering in the fall of 1996. Gerald Foster '51, associate dean for admissions, reported that each application is individually screened by a "pair of eyes," in order to assure that those unusual individuals who do not fit into computerized profiles can be identified. Candidates of interest are offered interviews in Boston or other sites. Approximately 160 to 180 non-Boston interviews are conducted by a Harvard Medical School representative along with local alumni. Any alumni interested in participating should contact Dr. Foster.

Approximately 200 students are accepted for a class of 165. Harvard expects that the entering class next fall will again be more than 50 percent women, except for the HST program which is about two-thirds men.

The LCME, the accrediting agency for medical schools, recently visited Harvard. James Adelstein '53, executive dean for academic programs, reported that the visit went very well. Harvard was lauded for excellence in education, curriculum development, faculty advising, and the quality of student interaction—the students being eager to take charge of their own education. Concerns included scheduling items related to HST and the New Pathway, a lack of faculty diversity, and a lack of attention to pragmatic matters, such as OSHA and tuberculin tests. A great concern was the student debt, which the Alumni Council has previously reviewed. All medical schools increasingly will face the issue of reimbursement for educational activities.

The business portion of the Alumni Council meeting dealt with the budgets (on target and modest) and the vital issue of inclusion of alumni. In order to encourage alumni participation, mailing will include opportunities to volunteer for participation in various Harvard alumni activities. Involved participatory alumni is the goal of the Alumni Council. The question of linkage through the Internet, which would facilitate communication, was also reviewed. Look for further updates on this. Finally, Alumni Week is, as always, a subject of discussion. Any suggestions for programming or of any kind, should be forwarded to Dean Dan Federman '53.

A glimpse of the current graduating class and the experiences of some of its individuals was provided by Edward Hundert '84, associate dean for student affairs. As expected, a bright and talented group of students will be graduating. The majority of those on the Alumni Council were awed by their achievements and accomplishments. An incidental discovery during this discussion was that Harvard Medical School keeps your admission essay on file forever. If you ever wondered how you "stacked up" to your original goals and expectations, somewhere in storage is your original essay. Whether this is retrievable on demand is uncertain, but we will let you know.

Finally, on behalf of all the Alumni Council, we thank each of you for your continued generous giving. Harvard Medical School receives better support from its graduates than any other medical school. You are an appreciated and important group. Your ideas, thoughts and comments, in addition to your financial contributions, are noteworthy.

I look forward to seeing many of you at our June reunion.

Stephanie H. Pincus '68 is professor and chair of the Department of Dermatology at SUNY Buffalo.

On the Quad

photo courtesy of J. Antony Swartz Lloyd

Mitchell Rabkin

Daniel Tosteson

HMS-BI HealthCare Foundation

The Beth Israel Hospital has boldly strengthened its commitment to medical student education through a joint venture with Harvard Medical School, the formation of the HMS-BI HealthCare Foundation for Research and Education.

By elevating the visibility of teaching and research, the two institutions hope to create a model for preserving and funding the academic mission of medicine, whose survival amidst the revolutionary changes in health care delivery has been threatened. It is the hope of Dean Daniel Tosteson '49 that similar arrangements can be made with the medical school's other teaching affiliates.

"The relationship between the faculty and clinical departments as they work towards their academic, as compared with their clinical care, missions is changing rapidly," says Tosteson. "Both missions require energetic and creative leadership. The new foundation aims to provide such leadership for the academic mission. We are fortunate that Professor Michael Rosenblatt will serve as executive of the foundation."

Mitchell Rabkin '55, president and CEO of the Beth Israel Hospital, was the first to respond to the dean's overtures and concern for medical scholarship because, he says, "we felt his ideas were on the mark and very timely." As Rabkin explains it: "The core 'business' of clinical medicine—payment issues, cost control, clinical protocols—puts a drain on the time and attention of each chief of service. But the core mission is more demanding as well. Teaching is no longer really done on sedentary patients; ambulatory patients enlarge not only the geographic venue but also the faculty, and place new demands on curriculum content, and on monitoring and coordinating faculty."

Research is increasingly demanding as well, he adds. "As we shift from organ and tissue-focused investigations in anatomy, physiology and biochemistry to a focus on genetic and molecular mechanisms, there needs to be stewardship by the chair that involves broader overview and greater insight, if scholarly excellence is to be maintained."

Conversations between Tosteson and Rabkin led to the formation of a small working group, where the concept of pooling resources to form a joint venture emerged. The idea is for the foundation to be headed by someone whose top priority is finding and directing new funding for education and research, facilitating the movement of medical student education into outpatient settings, and helping to implement solutions to such issues as teaching equity and reward. For the hospital, says Rabkin, this person is "someone who will focus on the core academic mission of teaching and research, and thereby assist the chairs through co-management of these responsibilities, in a manner that does not diminish the chairs' responsibilities."

The person who has taken on the challenge of establishing what might be a template for how medical schools and their affiliates can together preserve the academic mission of medicine is Michael Rosenblatt '73, the Robert H. Ebert Professor of Molecular Medicine, chief of the BI Division of Bone and Mineral Metabolism, and co-director of the Harvard-MIT Division of Health Sciences and Technology. To his already title-laden hat, he has added executive director of the Harvard Medical School-Beth Israel HealthCare Foundation for Research and Education, and in that capacity he will serve as faculty dean for academic programs at HMS and at BI, as senior vice president for academic programs.

"This foundation will help us facilitate the big changes that will have to be made in medical education," says Rosenblatt. "We're trying to get out ahead of the wave so we're positioned with a strong academic enterprise."

Though specifics of the plan are yet to be articulated, Rosenblatt has announced three immediate steps:

- establish a state-of-the-art center for clinical education for Harvard medical students doing rotations at the BI in the hospital's new ambulatory care center, the Carl J. Shapiro Center. It will have a skills area with simulators and dummies, carrels with computers, teaching programs on CD-ROM, digitized teaching files from radiology, and projection equipment for pathology review.
- start working with the BI's department heads in all specialties to look at ways to bring more clinical education into the outpatient setting. Starting this July, for example, the core clinical curriculum in surgery and medicine will expand to include more ambulatory teaching, which at the BI will take place largely in the new center.
- encourage through seed money more collaborative research between Quad-based and BI faculty—"a leveraged investment"—that could open new avenues of research, particularly those with the kind of clinical applicability that will attract outside funding.

Though education and research


photo by Barbara STeiner

Michael Rosenblatt

have been orphaned by reimbursement formulas and managed care plans that don't support these activities, the new foundation is going to try to turn its separation from the clinical business into a strength. An important part of the plan is to attract funding from benefactors—individuals, corporations and foundations.

"This money will be used 100 percent for research and education and not be blended with the operations of clinical service," says Rosenblatt. "As a separate organization, the foundation will be positioned to promote the academic mission." It can raise revenues and by being involved in their distribution to Harvard faculty and departments at BI, influence capital-intensive changes such as the redirecting of teaching to more ambulatory settings.

There are about 17 other institutions affiliated with HMS and it is hoped that others will do something similar. "This is an area where we can work collaboratively on medical student education, not competitively the way the clinical business has become," suggests Rosenblatt.

Each could have its own foundation as a way of teasing out the academic component from the hospital's clinical business. "The other thing this achieves," says Rosenblatt, "is that the head of the foundation serves as a focused voice of academic medicine in that hospital, just as there is a voice of surgery, a voice of dermatology, and so on." As director of the HMS-BI foundation, Rosenblatt, for example, sits in on key meetings at the BI and at HMS "When thinking over changes, I'm there to watch out for research and education."

The HMS-BI foundation may itself expand if a potential merger of the BI with the Deaconess Hospital and its Pathway Health Network of suburban hospitals—announced at the end of February—proceeds. Its network includes the New England Baptist, Deaconess-Glover, Deaconess-Nashoba and the Deaconess-Waltham hospitals, which could become involved in the foundation as well, speculates Rabkin. The Mount Auburn Hospital has also joined their merger discussions and would add further expertise in teaching.

How the other affiliates decide to support education remains to be seen. But what the Beth Israel is saying, according to Rosenblatt, is: "We all have to be concerned with the clinical business, but education and research are just as important. We're in partnership with Harvard Medical School to train physicians for the long haul."

To do this, Rosenblatt acknowledges, will take a lot of cooperation and collaboration between department chairs at the Beth Israel and the medical school. But big changes take big plans. "I have no doubt when historians look back, they will see these changes in health care as a revolution, the biggest thing in probably 100 years."

Through creative ways such as this foundation to help protect the academic mission of its teaching hospitals, says Tosteson, "the new foundation has the opportunity to restructure and restrengthen the educational and research programs of the Harvard Faculty of Medicine at the Beth Israel Hospital and hopefully also at the Pathway Health Network and Mount Auburn as they move toward merger."

Ellen Barlow

At the Juncture of Law and Medicine

Until now medical students at Harvard thought about legal issues only in medical ethics or law and medicine classes, while law students discussed medical issues in health care law classes. Though their worlds overlap at times, rarely did medical and legal students talk to each other.

In January 1995 this changed when three Harvard medical students joined nine Harvard law students to share common concerns, interests and ideas in a new month-long course entitled "Ethical Issues in Clinical Practice: Doctors and Lawyers in Dialogue." Co-directed by Linda Emanuel '84 of the HMS Division of Medical Ethics and David Wilkins of Harvard Law School, students heard from academics and practitioners in both fields on topics ranging from conflicts of interest to the changing relationships between professionals and clients.

We also explored each others' backyards—medical students watched proceedings in housing court and district court while law students observed physicians working in the outpatient clinic and the intensive care unit. We discovered that the overlap between our professions is impressive, and saw the value of dialogue between disciplines and the need for continuing work and collaboration.

The presumed antagonism between law and medicine, nurtured at times in each of our professions by various offhand comments and apocryphal stories, was addressed the first day when we discussed our reasons for taking the course. We discovered much congruence in how each field confronted specific dilemmas, ranging from financial conflicts of interest to issues of confidentiality and truth-telling. These ideas formed the basis of many of the specific sessions of the course.

There are, for example, a broad

range of conflicts of interest common to both medicine and law, in which a broad view of beneficence is poised against personal or financial enrichment. Perhaps the most obvious current illustration of this in medicine is seen in the potential tensions between the goals of a managed care organization and a therapeutic physician/patient relationship. In law, the needs of the individual client versus the needs of the firm form a parallel dilemma.

Another area of concern that cuts across both the legal and medical professions is the changing relationships between codes of conduct and actual practice. In the legal world, the Model Rules of Professional Conduct, which govern legal practice in a majority of states, assert that a lawyer's role requires referring to "moral, economic, social and political factors relevant to the client's situation," as part of legal consultation. In medicine, codes of behavior from the Hippocratic Oath to the American Medical Association Code of Ethics theoretically inform physicians' ethical practice.

Yet, as practitioners in both fields have experienced, the relationship between a code of conduct and ideals to everyday practice is not always clear. Many of us in medicine and law have seen the abrupt transition from the world of books and theories to the world of patients and clients and procedures. Attention must be paid to making this transition as seamless as possible. Medicine tries to do this through third and fourth-year rotations, while law does not have such formal and standardized apprenticeships.

Christine Solt, a 1995 Harvard Law School graduate, puts it this way: "No one would expect a surgeon to perform a complicated procedure without at least having observed the procedure performed and not based only upon prior discussions of the theory behind the procedure's use. But young lawyers are often expected to draft a contract based upon their ability to reason why it might need a particular clause, or to balance competing theories about the enforceability of form contracts."

Solt's words emphasize what is perhaps the paramount issue that links the specific areas that we examined in this course: the development of the practitioner and the transition from student to professional, whether a lawyer or a doctor. This development underlies everything else, whether the issue is a specific conflict of interest, the process of informed consent or any other ethical incertitude.

Our experience in this course made it clear to us that future students and practitioners in law and medicine will benefit from cross-disciplinary education and interactions. We believe this effort should be undertaken as a complement to courses in ethics and professionalism within each discipline and then continued throughout training in the professions, maybe even involving continuing education courses. The critical properties such training must have are the continued exchange of experiences and ideas, the recognition of areas of common purpose and shared values and, perhaps most importantly, the correction of the myopia that can so easily arise in both fields.

Joshua Hauser '95 and Paul TK Cheng '95.

Good Society

With an eye towards replacing antagonism with understanding, and opposition with cooperation between the fields of medicine and law, HMS students Brett Zbar, Akshay Desai and Derek Kunimoto, all Class of '98, this year launched the HMS Law and Medicine Society.

"As our health care delivery system continues to evolve, it becomes increasingly important for physicians to understand issues at the expanding interface between law and medicine," reads an introductory letter to first-year students. The society is particularly interested in how managed care "may dramatically alter the legal context" in which physicians make treatment decisions, say its organizers.

"Physicians often act with inaccurate perceptions about what the law is when making medical decisions," says Ellen Wright Clayton '85, who came to medical school after obtaining a law degree from Vanderbilt University and who spoke at the society's first symposium last year.

Terri L. Rutter

The Next Generation

by Robert A. Greenes

http://anyinfo.anywhere.4.u

AT WORK, AT HOME, AT PLAY, THERE is no escaping it. The Web is everywhere (note the capital "W" distinguishing the Web from an ordinary web, as spun by a spider, woven by a mystery writer, or making up a fish net). In the remote possibility that there exists a reader who does not know what the Web is, I am referring to the World Wide Web (or WWW), the phenomenon that has popularized the Internet and put the information superhighway within reach of anyone with a computer and a modem.

Wherever you turn—the newspaper, TV, radio, billboards, magazines—you are bombarded with those "http://" Web addresses to let you find the Thai restaurant nearest you, examine your stock portfolio, learn about new cars, check out local real estate offerings, or even learn the capital of Tanzania. Moreover, as Americans and citizens of the planet flock to this new "place" to be, and more people learn how to put their own information on the Web, it will be hard to hold out against being there yourself.

It is tempting to dismiss the Web as simply a way to occasionally look up something useful, like the weather or airline schedule, or the progress of your Federal Express package. Helpful, but hardly earthshaking, since this same information could be gained in many other ways—even something as retro as a telephone call—which don't require you to be plugged into a laptop with a modem or network card!

It may be easy to say that most of this is unedited, unfiltered piffle, the magnitude of which will only get worse and overwhelm us all, as everyone has his or her own "home page" professing to be experts on something. With the growing cyberglut, how will we be able to distinguish the occasional truly useful morsel of information from the tons of inane stuff, the edited from the unedited, the 1 helpful response from the 458 frivolous or outright incorrect items retrieved in response to a query? We are beginning to fall victim to a malady of the nineties—neurotica informatica or "information anxiety."

The World Wide Web may seem a curiosity to some, an object of hype to many, even a danger to others. These characterizations fail to recognize its essential impact on the future of how we live and work, perhaps nowhere as notably as in health care. Physicians are only scarcely aware of the profound effect this phenomenon is having on our profession—by facilitating the transformation of our health care system into a new one.

The nature of the transformation in health care is from a system dominated by monolithic institutions and practices and independent providers to one in which highly federated enterprises are emerging, in an attempt to cope with growing pressures on cost while maintaining cost-effectiveness and quality. Curiously, the information technology industry is undergoing a similar transformation from monolithic and independent software to applications based on highly federated components. The Web is a metaphor for such new software approaches. I will try to show how these two seemingly separate but parallel processes relate to one another and, in fact, how the changes in the health care system are being enabled by federated software.

The Web as metaphor

The Web is an example of a set of related developments that radically differ from most computer software you have used before. Because of its pervasiveness, the Web is not only an example but an apt metaphor for this group of developments.

The capabilities of the Web are a result of the confluence of powerful multimedia graphics-capable computers, high speed networking, and software that is able to access and utilize information in distributed, often far-flung locations. The Web is not itself a computer program but a set of rules or conventions by which messages can be sent from one computer to another and be understood. Web "applications" are simply collections of documents, connected through "hypertext links," pathways to other information.

The documents of a Web application are put together for a specific purpose, such as a *New York Times* summary of current articles, a weather map with detailed forecasts available for individual locations, or a collection of clinical guidelines together with explanatory notes and references. These documents are accessed and displayed on your PC (I use this term to refer to both IBM-compatible and Macintosh personal computers) by a program called a Web "browser" (a number of these exist, the most familiar being Netscape and Mosaic). Documents may contain a set of designated phrases, icons, or other design elements which serve as pointers (links) to other documents, which may

be stored on different computers or all on the same computer.

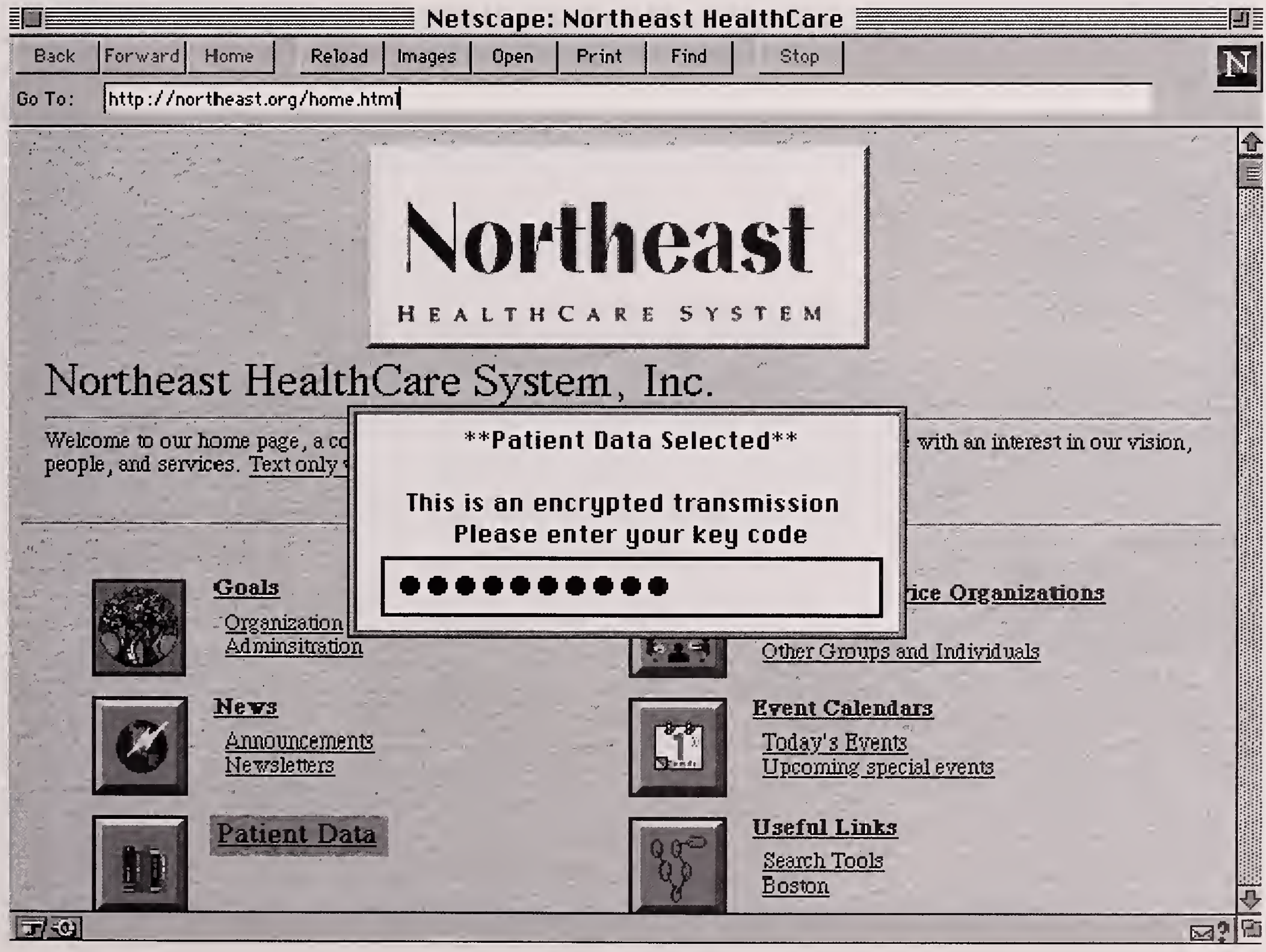
A Web application is unlike the typical self-contained application that you probably bought to do word processing, spreadsheet calculations, or slide presentations, and even more unlike the integrated packages that do all of these together (so-called "office suites"). These traditional programs are self-contained and barely use a network, except perhaps to share a printer or to store files in a common shared disk. The Web is also very different from the information systems used in typical health care institutions, which may also utilize networks, in that those systems are typically highly integrated packages, running on one or more large central computers, to which terminals or workstations may attach and send and receive information.

The Web differs from both of these models in that its applications rely intensively on the network for all of its information. The only requirement is that the computers containing the information be connected to the Internet and have Web server software that allows them to communicate in the standard Web-compatible format.

Extensions to the Web model have occurred. For example, the Web browser you can run on your home or office computer is designed to retrieve information from network-connected computers in the form of documents—yet this need not be limited to "static," previously created documents. A Web browser can be used for querying databases, with the results of the query shown in a displayed document; however, in this case, the document is not static but is generated dynamically by the remote computer that has searched the database. The source could be a patient database, a Medline journal database, or a clinical guideline repository.

Other extensions to the Web browser allow you to enter information, not just retrieve it. This could be as simple as entering a query term for a literature search, or selecting a movie for which you want to retrieve a review, but it can also include filling out rather detailed forms, for example, for ordering a product, registering for a meeting, describing a patient's physical findings, or entering discharge orders. This information, once collected, is sent by the browser to a distant computer for processing or storage in its database. A "browser" is thus sort of a misnomer for the program used to traverse the Web, since it is not only used for retrieving information but can also function as a "transaction processing" interface for carrying out various activities—like

A regional medical network's home page, in which Patient Data has been selected.



patient care!

Web-like capabilities are extended further with small application programs known as "applets." One such approach uses a language known as Java (developed this past year by Sun Microsystems Inc. and already supported by many hardware and software companies) to write applets that can run on essentially all common models of PCs. The impact of this is significant.

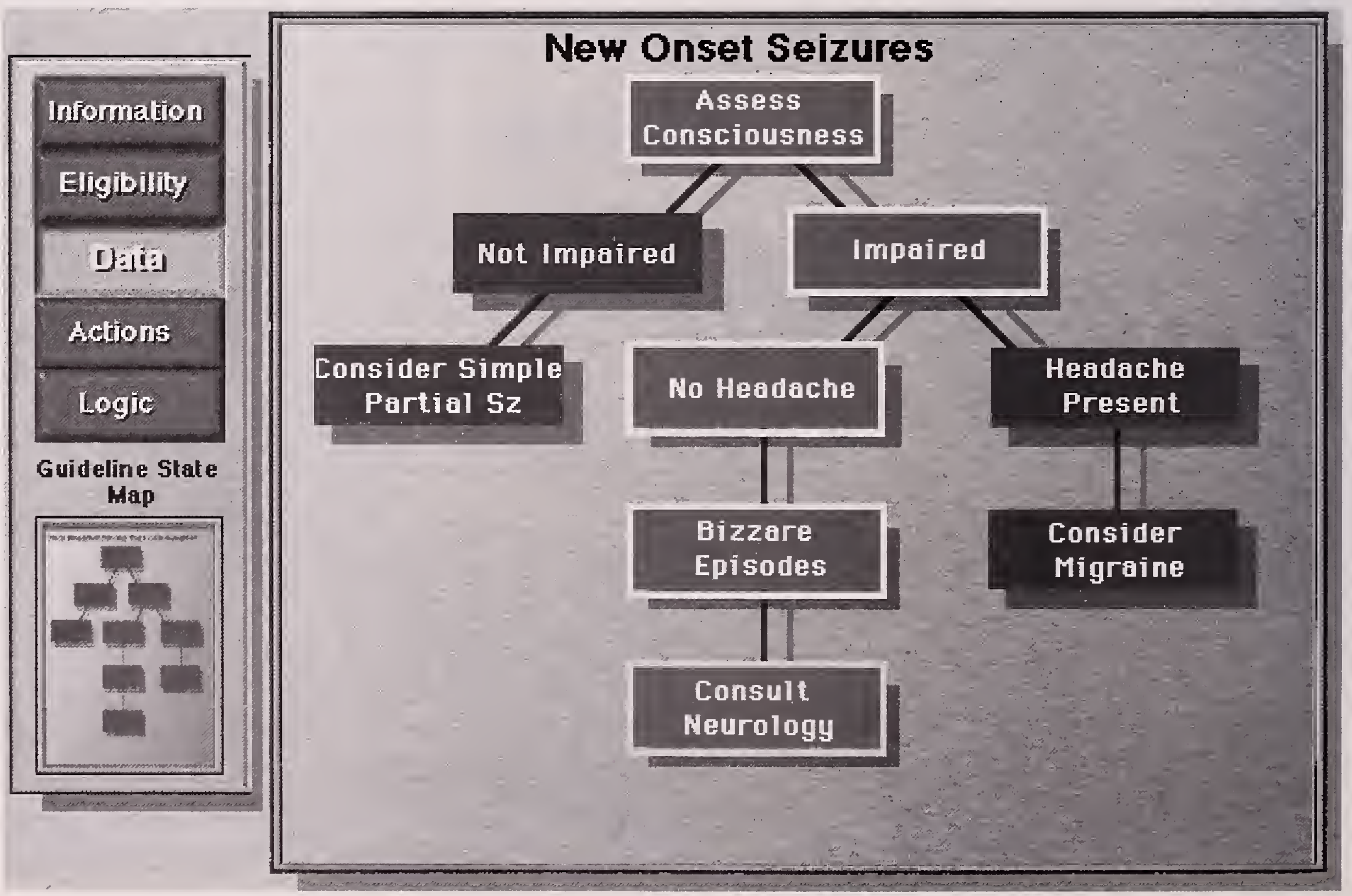
Consider your word processor, a single behemoth of a program chock full of features you may never use. Such "bloatware" could be replaced by a very small Java program for text editing. When you want to do a spelling check, an applet for this is brought over the network. To do equation editing, yet another applet is brought over, and similarly for other functions such as mailing list merging, inclusion of a spreadsheet table, or incorporation of a drawing. A clinical workstation application could be implemented with Java in such a way that lists of laboratory values could be retrieved from an electronic record system, for example, and plotted graphically, or a radiologic image could be displayed and its brightness and contrast manipulated, or rotation of 3-D images could be done.

Some major computer companies have gone so far as to develop basic "Internet machines"—available within a year—in which standard software packages and disk storage on your PC will be unnecessary, since the Internet will be both the source of all needed software applets and also will be able to store and retrieve your files for you.

The Web and extensions are examples of several technology developments enabling the Internet to be used to link together information resources—documents, databases and application modules—housed on separate computers. The Web is, by virtue of its popularity, a major method for accomplishing this. But other approaches aim to integrate visual objects on your computer screen (such as buttons, menus, lists, images, text elements, drawings and charts) in flexible ways such that these visual objects are actually produced and controlled by remote software components on other computers. This means that the application you are running on your computer is like the conductor of a musical score, indicating what elements should be played by what orchestra member at what time, but the actual responsibility for doing these things is not in the application but resides with the orchestra member.

Again, a clinical workstation application is one such example, where a visual display of a medical chart with divider tabs could be used to page to specific sections, where the information contained is actually retrieved from other connected computers. Forms for entry of new findings or links to expert systems producing advice about likely clinical problems based on the displayed information

A guideline for seizure workup and management with a path highlighted suggesting referral to a neurologist.



could also be visually incorporated.

The information technology industry has been turned on its head. Prominent solitary applications for personal computers are soon to be replaced by, or at least have competition from, applications made up of federations of network-distributed components. Major applications for business, including health care systems, will go through a similar transformation; in health care, patient data, clinical images, guidelines, decision support modules, educational resources, and e-mail/communication tools will soon no longer need to be integrated into single institutional systems, but will be woven together from disparate components.

A "Lego block" approach

The technology I have described is based on the notion that it is a good idea to build applications by identifying individual, useful tasks, building separate components that accomplish those tasks, and then integrating the components in specific ways to create unique applications. This "Lego block" approach has a number of implications for health care information systems.

First, in an effort to find a market niche, component producers can be expected to strive competitively for the best components for clinical data access, image processing, diagnostic expert system, Medline retrieval, form-based data entry, voice recognition, or guideline display. Databases of drug information, laboratory reference values, and national or international pooled clinical trial results will all seek to be accessible, authoritative, up-to-date and complete.

Second, applications—that is, programs that integrate components—can be customized, adapted to the requirements of the user. It will be relatively easy to develop specific programs for nurses, physicians, medical students, educators, researchers and managers. Programs can also be further adapted for specific purposes and preferences, e.g., whether you want to examine patient data in chronological order, according to source (progress notes vs. labs vs. radiology), or by problem; and how you want to input data (by voice, pen, mouse or keyboard) and output it (tabular, narrative or graphic).

Third, re-use of the same components will be possible in different applications. The same image processing tools could be used in a student workstation application or in one for a practicing radiologist. The same database—e.g., patient data, Medline or drug reference—could be used by a primary care physician or a cardiac surgeon, but organized in a different format, according to the way that person's workflow is carried out.

Finally, "extensibility" is relatively easy. New components can be integrated into applications, or the application can be updated to provide new ways of accessing components.

There's a Web in Your Future

Web-based applications are beginning to find their way into health care systems. Columbia Presbyterian Medical Center in New York is using the Web as a means for accessing patient data. The Web's primary role is as a "front end" (a visual, graphic front end that can run on virtually any kind of computer) to a variety of existing "legacy" systems that currently maintain administrative and demographic data for patients, laboratory, x-ray, pathology and other results.

The clinical profile of one of the available neurologists, who has a clinical interest in seizures and speaks Spanish.

A major concern here, of course, is security and protection of privacy of data such as a patient's clinical record. The software industry is developing technological approaches to this, as the health care industry is seeking to develop policy and procedure for determining access privileges and authentication of users.

At Partners HealthCare Systems, we are using the Web as a means for supporting a developing regional network of patients and providers. The Web will serve as the interface for access to information about the various heath care institutions in the regional network, including the Brigham and MGH, the departments and their services, the participating physicians, upcoming seminars and other events. Primary care physicians will be able to obtain problem-specific guidelines and other educational resources, enter data and send messages. Patient data will be accessed via this method or another network approach, based on security considerations still being evaluated. However, in this environment, both patients and providers will use the

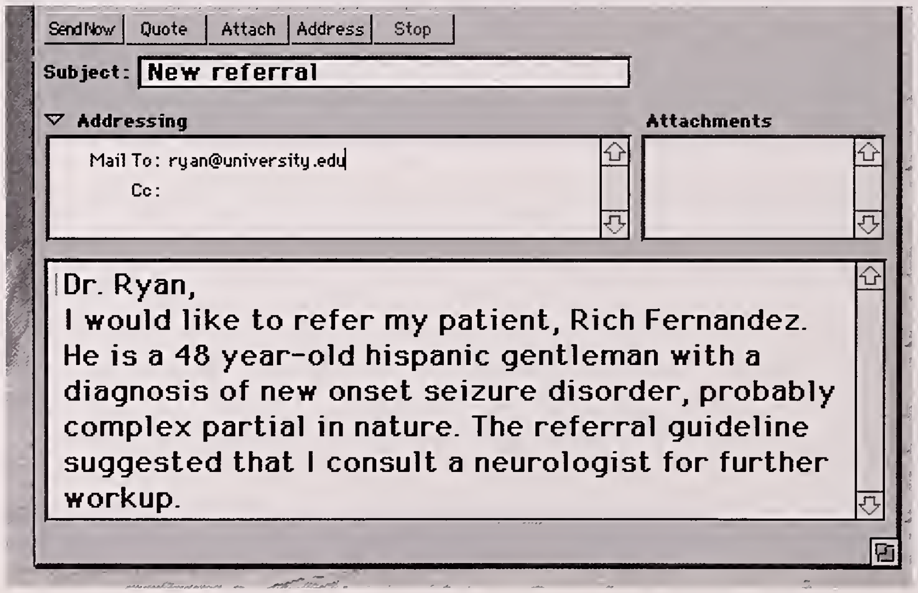
Web as a primary means of communication, information access, education and decision support.

Further evolution of these approaches is not hard to foresee. Current dedicated systems for specific functions—such as patient data access, clinical image review, guideline or educational reference, MEDLINE search, decision support, e-mail communication and practice management—will either be replaced or function as "back end" data sources and processing engines for a set of applications based on the Web, Java and other component/integration technologies. We will have new applications that provide access to all the tasks necessary for our daily work via a single, consistent user interface.

Emergence of new health care enterprises

Changes in our health care system are necessitating that we all use computers. New forms of health care enterprises are developing: regional health care networks are now tying together patients, primary care, community hospitals, tertiary medical centers, and a variety of other supporting services. These are blurring previous institutional boundaries and making the "brick and mortar" of institutional walls less meaningful. To become efficient, certain services such as radiology and pathology have begun to seek vertical market niches on a national or even international scale through teleradiology and telepathology systems, further loosening geographic and institutional constraints. Multi-institution health care chains are now seeking efficiency by incorporating services, such as imaging, which may be geographically remote from where they are used. This is resulting in new alliances.

An e-mail message to the consultant with a summary of the workup.



As the health care system transforms from independent, separate providers to a new system relying on federations of providers and services, former individual providers are being looked at as components—e.g., a radiology group, a clinical laboratory, or a neurosurgical service—which must compete to be part of new enterprises. The enterprises are integrating these components in various ways. Health care is becoming a cooperative activity in which the patients, physicians, health care institutions and other resources must share information and operate more cost effectively.

The information needs for such cooperation grow dramatically as the complexity increases. In the midst of such enterprise change, existing institution-based and free-standing information systems will be relatively difficult to adapt to the new requirements. It is curious that both health care and the information technology industry are going through similar transformations at the same time. Both are in the midst of breaking up into components that can compete in the marketplace based on cost and quality, and of integration to deliver new combinations of capabilities.

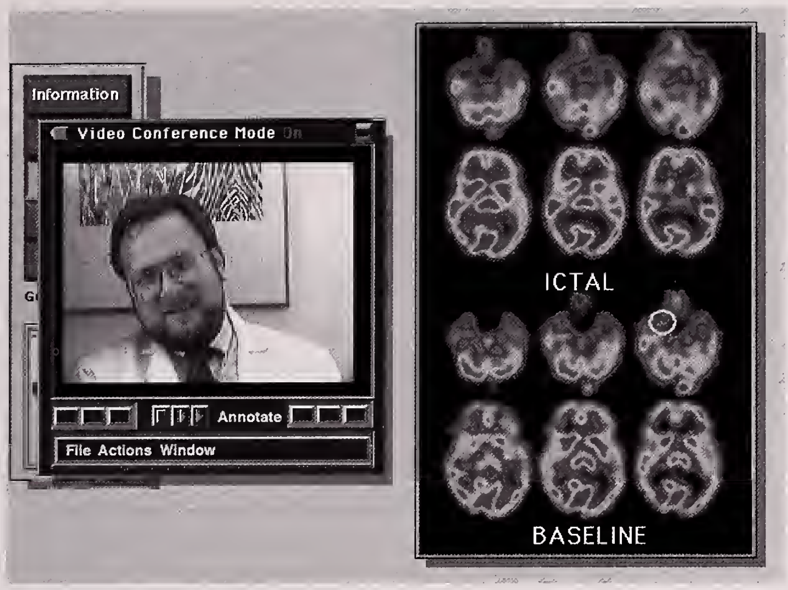
To be sure, the genesis of the transformation in health care is different from that occurring in the information technology industry; it has been brought about by a cost crisis that has driven major changes in financing mechanisms. The changes in information technology have in a sense been more self-evolving as a kind of "technology imperative," developing out of trends in object-oriented software methodology, workstation processing capability, high-speed networking, and the emergence of protocols and standards for communication and message-passing.

The changes in the health care system are increasingly dependent on information technology. It is now likely, even inevitable, that much of our health care will be conducted over interactive networks, whether they be communication between a patient through his home television set and a doctor in her office, between a doctor and a specialist, between a consulting surgeon guiding or even performing a remote procedure and others on-site, or among a team of doctors in consultation using an on-line decision aid.

Robotics and remote sensors, transmission of sound, images, and motion video, and integration of decision aids are loosening the dependence on physical proximity just as our health care institutions are seeking ways of reformulating themselves to be more cost-effective and competitive, while maintaining quality. They are also striving to differentiate themselves from their competitors by offering wider ranges of capabilities and added value.

An organizing paradigm

A major additional element that will occur in health care is the integration



A video message back from the consultant, with results of a SPECT study showing abnormal seizure activity.

of guidelines for clinical practice. This integration will happen largely through information technology. A guideline can be a tool for education and training, for reference in a problem solving situation, for audit and monitoring, for detecting untoward events, or for fostering improved workflow.

Although clinical practice guidelines are often looked at by physicians as unwelcome constraints on patient care, they may well become primary organizing tools for health care information access. Consider the growing dependence on guidelines in our health care organizations, not only for clinical decision making, but for prospective approval, claims review, utilization review and quality assurance, and education. Rather than being bothersome impediments, guidelines can serve in new systems by organizing workflow and anticipating information needs.

Imagine that you are a primary care doctor seeing a patient with a problem of persistent dizziness, which you have worked up and believe to be of neurological origin. Even if not highly specific, a guideline may help you not only in the specific workup and management, but in providing an organizing method and access point for a variety of problem-specific resources you may need. For instance, once you have pinpointed the place in the guideline (a clinical state) that pertains to the patient, links can be made automatically by computer from this clinical state to an information tool that retrieves specific stored clinical data pertinent to this state; to another tool that displays a form indicating data useful to collect; to another suggesting various actions that can be ordered—with links to references detailing the circumstances in which these are most appropriate; to another that provides a list of specialists in the health care plan who have expertise in this area, together with their resumes, photograph and e-mail address; to a variety of other decision aids and educational resources, and so on.

Further, if you decide at this point that the patient needs an MRI scan, a document describing this process could be downloaded and given to the patient (or the patient can access the information from home via its Web address), along with driving and parking directions to the MRI facility. If the patient is to undergo a surgical procedure, information on the operation, expected post-operative symptoms, stored interviews with previous patients answering frequently asked questions, and other material can be given to the patient.

Elements of the long-term goal for enterprise information support are finding their way into our Web-based developments for Partners HealthCare System. The Web and related capabilities are very enabling, since new providers, services and clients are relatively easy to integrate into the system.

My primary message is that our approach to the health care system needs to be flexible, as we adapt our institutional and professional relationships to the realities of cost containment and the need for systemic cost-effectiveness and quality. These new realities mean that sometimes locally suboptimal practices (e.g., less patient volume for a service) may be optimal from the perspective of the patient's care. Time and place are less likely to be barriers in the future. As specialists we may provide consultation about unseen patients, and as primary care physicians we may deal with far-flung specialists and ancillary services. We will also heavily use information resources, and workflow and guideline tools will always be at hand.

This means that we all need to understand our potential roles in this new federated world. We must understand the information needs that have to be communicated and the information resources and tools that can help us. Cyberspace has met health care and the system will not be the same.

The usefulness of what we forge is up to us. Well chosen component services, sensible methods of integration, empirically based guidelines, and reliable information support are what we must seek.

Robert A. Greenes, MD '66, PhD, is HMS associate professor of radiology and director of the Decision Systems Group at the Brigham and Women's Hospital.

Medicine On-Line

by Jerome P. Kassirer

About a year ago Partners HealthCare President Sam Thier was asked to speak about how he thought medical care would be delivered in the twenty-first century. He began by explaining that the pace of change in the delivery of medical care was so fast that he wasn't even sure what it would be like when he returned to his office that very afternoon. He was only half joking. Hospitals are rapidly losing their dominance in health care delivery; physicians are no longer the principal decision-makers; industrial-size health care networks built around managed care plans that enroll large numbers of people are flourishing; and a few giant insurance companies influence the kind of health care that is being provided.

These profound changes in the delivery of care cloud our vision of the future, yet three subtle trends are surfacing that are likely to have an enormous influence on the delivery of health care in the next century. I refer here to the rapid growth of computer-based electronic communication, the familiarity of a new generation with this kind of information transfer, and the shift toward giving patients more responsibility for decisions about their health care. These trends may well lead to cultural changes in the delivery of health care that are even more revolutionary than its current restructuring.

At some future time, I believe, on-line searches of databases will produce a better informed public and computer-assisted communication between patients and physicians will replace a substantial amount of the care now delivered in person.

Many people already own personal computers and use them in their studies or business activities, and many are using the Internet to communicate with colleagues, friends and family members. Over the past few years, the Internet has grown remarkably. The number of users is somewhere in the range of 7 million to 30 million, and many new networks are being added daily. New software tools, including free client-server programs, are making the computer files, bulletin boards, World Wide Web pages and newsgroups on the Internet more accessible and easier to find. Companies such as America Online, CompuServe and Prodigy offer menu-driven search and e-mail packages that are simple to use and relatively inexpensive.

At the same time, technology is catching up. "Smart boxes" and "smart television sets," which combine the functions of the computer, telephone, fax machine, compact-disc player and television will simplify electronic communication even more. The widespread extension of fiberoptic and coaxial cable communication across the country will speed up the transmission of all types of digital signals. Finally, the concomitant increase in patients' willingness to take more responsibility for their own medical care will have an important impact on the use of the Internet for medical care.

At present, the medical information available on-line for the public is limited, yet commercial services already provide "textbook" information that is comprehensible to an intelligent layperson; and on-line discussion groups about topics such as diabetes, eating disorders and vitamins are growing. The problem is that much of the information conveyed in these forums is of questionable parentage and doubtful validity. Some medical centers, however, are hosting their own on-line discussions, to which professionals from that center contribute information. Industry is sure to follow.

How could care be provided on-line? In principle, responsibility for decisions could be shared by the patient and the physician. The patient could search for information in authoritative medical databases prepared for lay audiences. Common problems such as urinary and upper respiratory infections could be handled by the patients themselves with the aid of on-line algorithms. Even some complex clinical problems could be handled by an on-line consultation with a physician.

Changes in the dosage of insulin, anticoagulants, antihypertensive drugs or diuretics, the management of many childhood diarrheas, and decisions about when to give tetanus boosters and when during labor a woman should go to the birthing center are but a few examples. Standard reminders for many routine screening tests or vaccinations could be sent electronically. Chances are that many people will be quite comfortable with this kind of interaction. Imagine: a new kind of house call by a "virtual physician!"

Although a health care delivery system that depends, even partly, on on-line communications holds considerable promise, the problems it poses are enormous. Familiar issues such as the continuity of care, the

validity and consistency of the available information, privacy and effects on the physician/patient relationship will all surface as major areas of concern. An even greater concern is the possibility that an electronic form of medical care will be introduced for the principal purpose of cost savings and that it will circumvent physician involvement and yield inferior quality of patient care.

There are many practical limitations to an on-line system of health care delivery. Despite the recent expansion of on-line communication, we do not know whether the public will accept this kind of medical consultation, or whether improvements in science education will increase the public's ability to understand medical information. Issues such as ease of use will have to be addressed; undoubtedly many people will lag behind in taking advantage of any kind of on-line information, and some will never use it.

People who do so are likely to be barraged with conflicting reports, varied opinions and contradictory recommendations. We will have to learn what kinds of medical problems can be safely and effectively handled by physicians who are remote from their patients. And a new conflict will emerge: some mechanism will be needed to foster the appropriate acceptance of responsibility by patients for their care while providing protection against dangerous self-diagnosis and self-treatment.

Some people will object to receiving some of their care by computer. They will still want to hear a human voice on the telephone, even though it may take hours to make contact with a physician. No doubt something important will be lost if physicians no longer see patients in person for everyday problems: the "laying on of hands" does have therapeutic value. Maintaining the confidentiality of sensitive, personal information is still another extremely important issue. Nobody but the patient and his or her physician should know, for example, that the problem is blood in the stool or sexual dysfunction.

Imagine a new kind of house call by a "virtual physician!"

Affordability will become an issue if the government stops supporting the Internet. Companies such as America Online and CompuServe will certainly offer many more services, but they will charge, and whether the free services offered by universities will be continued is yet to be determined. Because the cost of the new technology will further widen the gulf between those who have access to care and those who do not (or at least exaggerate the difference in the quality of care between the two groups), it will be critical to find a way to protect and treat those who are unable to use or pay for an on-line system.

Widely implemented on-line systems would have a profound effect on those who provide health care. Integrated networks for the delivery of medical care will have methods of tracking the care provided and the costs of that care and the same system could be used in an electronic network to communicate with patients. Physicians would be expected to interpret much more information in that case but they, too, would have access to far more up-to-date data.

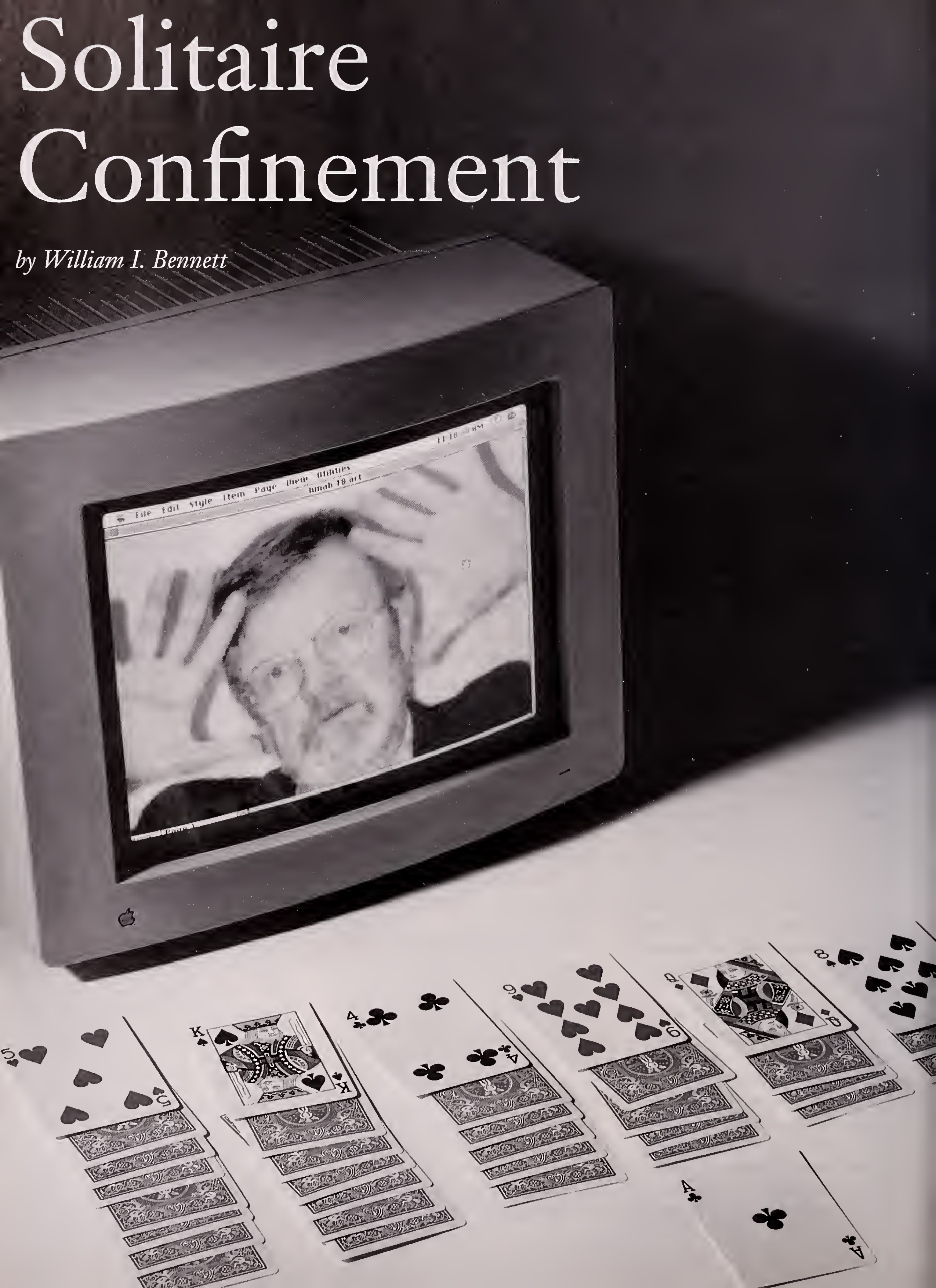
Establishing credentials, licensure and the definition of malpractice will take new forms when medical advice and decisions are transmitted by a communications medium that crosses state and national boundaries. The nature of a patient's medical record will also change. Inevitably, an electronic data repository will be developed for each patient, but deciding what form it will take and which institution or entity should be responsible for maintaining it will require considerable attention. If much health care is handled on-line, personal encounters will focus principally on the most serious problems. In that case, we might need even fewer primary care physicians, nurse practitioners and specialists than the numbers predicted today.

We must not ignore these remarkable trends and prospects. Although it is easy to identify what might go wrong in delivering medical care on the Internet, there are cogent reasons to believe that on-line medical communication also provides important opportunities. Better informed patients, more efficient use of resources, and enhanced communication between doctors and patients are possible outcomes. For the benefit of our patients, physicians should be at the forefront of these changes, not dragged along by progress.

Jerome P. Kassirer is editor-in-chief of The New England Journal of Medicine *and HMS lecturer on medicine.*

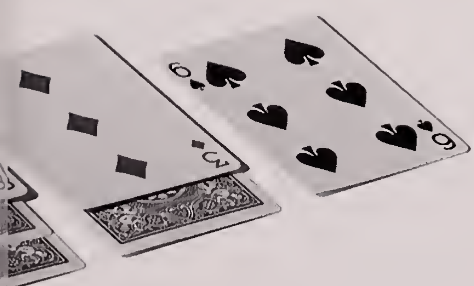
Solitaire Confinement

by William I. Bennett



My slide into abject addiction began when I bought a new PC. The previous one was a serviceable laptop, six or seven years old, with a slight wheeze, a slow chip, and a blue-gray screen. The new one, purchased last summer, is already a little quaint but at the time was edging toward the high end of the market for home or small-office equipment; it came with a fast chip and vast memory, a CD-ROM drive, and speakers resembling the eyes of a highly-evolved insect prepared to exsanguinate me.

My fantasy, of course, was that my productivity would increase in proportion to the enhanced firepower of this new gadgetry. Not only would I know how Prozac interacts with drugs from gold salts to melatonin, I would be able to generate road maps for every Springfield in America and recall every Avercamp, Boticelli, Crivelli, and Delacroix in the National Gallery. At the very least, I should be able to get my bills out on time.



In the event, it was the telephone book on CD-ROM that tripped me up—not the program itself, but the fact that its 85 million U.S. listings on half a dozen disks all formed an elaborate shell encasing an innocuous-seeming, but for me virulent, agent directly attacking brain tissue. A computer game packaged with the utilitarian directory—and one of the least elaborate, least interesting of the lot—was my downfall.

Virus protection was something I knew about and was prepared for. What I did not anticipate was that my self-image as Cortez gazing from a peak in Darien at the boundless riches of Silicon Valley would expose me all but fatally to a foreign disease against which I had virtually no immunity. In sum, a version of solitaire came to dominate my life for nearly six months and still, if I let my guard down for a moment, renders me paralyzed for hours afterward. Nothing in my earlier experience predicted this.

Since childhood, I have had little interest in games, brain-twisters, or puzzles of any kind. Three college roommates devoted to bridge quickly discovered that I gave new depth to the term "dummy." In the past 40 years I have attempted the *Times's* crossword puzzle perhaps half a dozen times and have never completed it. I have, in my time, read countless mystery stories, and without exception have not guessed the murderer until several pages *after* his or her identity has been explicitly revealed by the narrator. I did fall in with dubious company for a while in my late 30s and as a result acquired a passing taste and a very limited talent for pinball. Unable to convert to Pac-Man and its descendants, I have not dropped a quarter into anything but a parking meter or a washing machine for over a decade.

I am not proud of this aspect of my personality. I firmly believe that creative people in most fields must be active puzzle and game fans. A good game provides structure while inducing fantasy, free association, and bloodthirsty competitiveness—the same traits that yield poems, theorems, musical compositions or scientific hypotheses. Something about my inability to become engaged in a game betrays an unpleasant truth about my mind, a crucial defect in my capacity for curiosity, or at least in the range of things about which I'm able to be curious.

This blunting of intellect should confer at least some protection from the dark side of game playing: the mindless waste of time. Not so. The mindless part seems to be what has hooked me.

How did this game penetrate my habitual defense of apathy? I can only guess. Unlike the standard version of solitaire, which in computer form comes packaged with Windows, FreeCell solitaire begins with every card face up. The challenge is to move cards around according to certain rules until they're all piled up by suit. The purveyor of this "logic puzzle" makes two claims for it: (1) "there is no luck involved after the initial shuffle" and (2) "it is believed (although not proven) that every game is winnable." If both propositions were true, the game would be a two-dimensional version of Rubik's cube (another in the long list of games that I have been unable to tolerate for more than nanoseconds at a time).

The first assertion is in a trivial way false because, as the computer version of the game is designed, the two red and two black aces cannot always be distinguished from each other at the beginning of the game; thus, the player may have to make many moves with no hope of predicting their consequences. It is my hunch that the second and more fundamental proposition is also false, but the easiest way to demonstrate this would be to find a deal in which no card after the first four can be moved, and there appears to be no such hand. This leaves the more daunting task of proving that at least one of the 52! possible deals cannot be won.

The software offers only 32,000 of these deals, and by now I've played a frighteningly large fraction of them, losing about half. This is a truly dismal fact of my current existence. Unfortunately, the people closest to me have behaved in thoroughly co-dependent ways, murmuring empathic remarks that only enable me.

"Of course, you're tired at the end of a long day working so intensely with people's emotions. Why wouldn't you want to relax with a nonverbal game?" Here's why: I'm only really good at this game when I'm in peak mental and physical condition. Playing it at the end of the day is a considerable waste of time. Playing it when I can meet the challenge (say 9 o'clock in the morning) is an utterly devastating waste of time.

"Well, at least this is one place in your life where you can put things in order." Yeah. Except that in the hours I've spent trying to maneuver a black jack onto a red queen I could have filed a lot of reprints and done my taxes.

How did I wind up in this abyss? Why couldn't I at least play the electronic chess game that also came with the computer? I can answer the second question. The chess program reliably humiliates me and usually within ten moves. Winning solitaire about half the time seems to be the optimal schedule of reinforcement—not too frustrating for this pigeon and not so easy as to be meaningless.

Moreover, winning proves not to be the only reinforcement. I have found that if I play the game long enough, I start to hallucinate. It happened first when I was recovering from a brief febrile illness and played for several hours straight. After a while, I started to hear a voice. The words were indistinct, but the accent was clearly Irish. Subsequently, I have heard several regional British or American accents and, occasionally, French-accented English. The speaker may be either male or female, and the sensation is always utterly pleasant. As time has gone by, the voices have appeared after ever shorter intervals of playing the game, although I must be alone in the house with no music playing in the background. The temptation to achieve this state of mind is often considerable, as I have not experienced it in any other way. (Strictly speaking, this is a form of dissociation, but I prefer to think of it as hallucinating.)

I doubt whether I would ever have become hooked on this game—or experienced the hallucinogenic effect—if I had to play it with physical cards. The computer allows the experience to become as nearly a disembodied act of nonverbal thought as it could be. Only the slightest movement of a mouse held comfortably in my right hand is necessary. The program makes the physical moves for all practical purposes at the speed of light; it cheerfully infers that I want to move a stack of cards exactly when I do want to; and the instant a win becomes inevitable, it scoops all remaining cards from the virtual board to the virtual winning piles.

Illuminating as all this has proved to be about my own psychology—demonstrating so clearly that my Achilles tendon inserts directly into my brain—it also says something about America. I know a lot of other computer owners with a guilty secret very similar to mine. Unfortunately, I think we will never be able to form Computer Games Anonymous, for the simple reason that it's much easier to be anonymous in person than through the Internet. So I venture to say that what this country needs at least as badly as the V-chip is a G-chip, which can ruthlessly scan hard disks for games that seduce even the sturdiest and most productive of the remaining Puritans.

William Ira Bennett '68 is HMS instructor in psychiatry at Cambridge Hospital and editor-in-chief of the Alumni Bulletin.

The Giant Brainstorm

He started out with two potatoes for thalami and a bowl for a cortex. Then three years ago Majid Fotuhi '97 devised two five-foot-tall models of the brain to use as a teaching aid. But now Fotuhi's vision has appreciably grown: he would like to build a five-story-high "Giant Brain" pavilion that the public could walk into and—through hands-on games, virtual reality and interactive CD-ROM programs—learn such things as how vision works, how drugs change moods, and how memories are formed.

But the idea started with a simple spud. Teaching while pursuing his doctorate in neurosciences at Johns Hopkins, Fotuhi yearned for a three-dimensional model that could help medical students struggling with neuroanatomy. Pictures in textbooks are two-dimensional and drawn from different angles. Students appreciated the potatoes (and other vegetables he used), says Fotuhi, because they provided a framework for understanding the three-dimensional organization of the brain and crossing pathways.

"Then I came here and I thought, I'm at Harvard Medical School, I can't use potatoes anymore!" He wrote a grant proposal for $10,000 and, with the support of Gerald Fischbach, chair of neurobiology, received the money from HST to hire two art students from the School of the Museum of Fine Arts, Andrew Lisle and Hillary Harrison, to build two five-foot models.

All along, Fotuhi admits, he really had something much larger in mind. With the success of the model, he went back to Fischbach and told him of his idea for a walk-in model of the brain that would make learning fun. "The scheme is ambitious, unusual but creative all at the same time, says Fischbach. "It is refreshing to witness a young physician/scientist who is willing to paint in such broad strokes." Fischbach gave him names of people to talk to and Fotuhi has since written a proposal.

"The brain is so intimidating to people, yet almost everyone is affected or has someone in their family affected by brain diseases such as headache, depression, stroke, Alzheimer's, Parkinson's or MS,"

says Fotuhi. "I have found that once I explain to patients in simple terms what disease they have, they can cope with it better." Knowledge is also the key to prevention, which is why he also wants to show the effects of addictive drugs and techniques for reducing stress.

Fotuhi says that he enjoys making science understandable: as an undergraduate at Concordia University in Montreal, he started a program called "Fun with Science" for children ages 6 to 12, which he continued at the Maryland Science Center. He also taught adult education courses on brain chemistry at Johns Hopkins and, at Harvard, he now teaches neurosciences and pharmacology to HST and other HMS students.

Fotuhi's original concept is a pavilion as sketched by the same artist, Andrew Lisle, who built one of his brain models. Visitors would walk in through the pons into an open lobby and take escalators up through the cerebral aqueduct to the third ventricle. At the bottom and both sides of that ventricle is the hypothalamus, where there would be an exhibition filled with hands-on experiments and games about what it is and how it controls sex, thyroid and other hormones. From there, people could continue by going through the foramen of Monro to the lateral ventricle, and on to the different lobes of the brain. In the temporal lobe, for example, they could learn about Alzheimer's and language acquisition, play games to increase memory and, in the amygdala, learn about fear.

In addition to physically exploring areas of the brain, Fotuhi would like to use computer and virtual reality technology so visitors "walk" to other corners of the brain and learn how different lesions affect behavior. He pictures people viewing a 3-D animation of a neuron by using a computer program developed by Rick Rogers, a consultant in cytobiology and microscopic tehnologies at the Harvard School of Public Health, which would enable people to appreciate neurons exposed to alcohol, cocaine and coffee.

Fotuhi doesn't shy away from a grandiose plan that he acknowledges could take years to find funding for and to build. He tells the story of how he hid in a bathroom in his native Iran for two years after graduating from high school to escape being drafted into the war against Iraq. "I told a friend of my father's then that I wanted to go abroad, go to the best university, and be a doctor. He responded, 'But you can't even go out this door.' But here I am."

After three failed attempts to escape Iran, Fotuhi managed to run away through a desert to Pakistan, smuggle in his younger brother and get them both passports by pretending to cooperate with drug smugglers. He then entered Canada as a political refugee. As he attended Concordia University, he worked to free the six other members of his family one by one; still he graduated as valedictorian of his class.

Fotuhi has already made some progress. He has spoken with John Shane, the vice president for programming at Boston's

photo by Liza Green

Museum of Science, who likes the idea of the Giant Brain but suggested that he write up a proposal for a smaller 3,000-foot exhibition that could be mounted inside the museum. Fotuhi has also reached William Winn, professor and director of the Learning Center at the Human Interface Technology Laboratory at the University of Washington (their virtual reality program). Some researchers at this center are using virtual reality to simulate the environment inside the neuron when the body intakes various drugs—just what Fotuhi wanted to incorporate into the exhibition! They have agreed to collaborate with Fotuhi and further develop their virtual reality systems to simulate the environment inside a neuron and then inside the brain. "Imagine experiencing the speed of action potentials traveling down an axon," says Fotuhi.

Though his ultimate project, the "Giant Brain," may be years away, Fotuhi is clearly excited about the positive response. "My number one passion is taking care of patients, but I can envision spending part of my time after residency on this project," he says. "This is a dream I've had and I think it's a worthy dream."

Ellen Barlow

Artist's rendering of the "Giant Brain."

Above: Majid Fotuhi teaching with his brain model.


http://www.med.h

HMS Spins a Web

by Terri L. Rutter

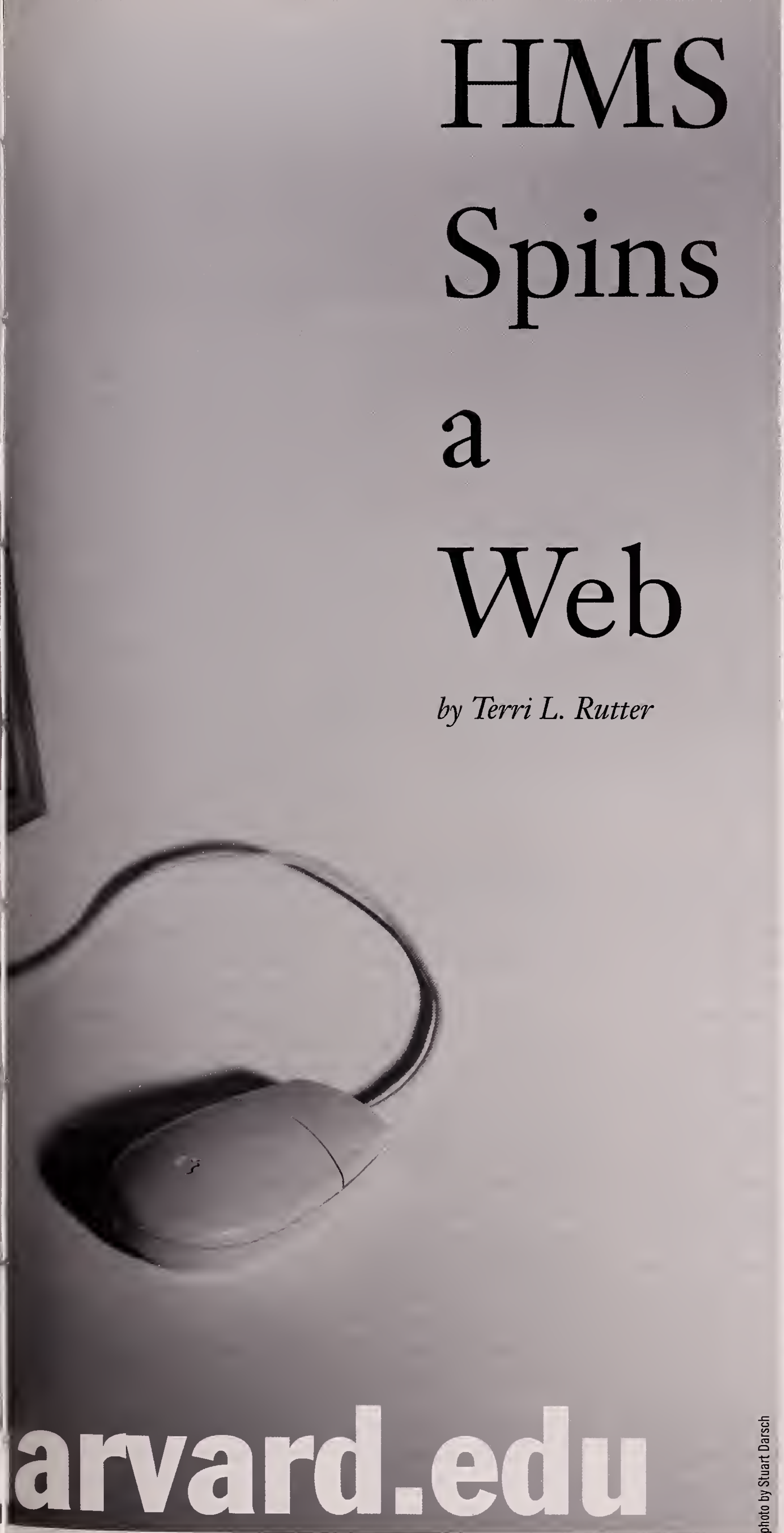


photo by Stuart Darsch

The Internet, that super network of computers zapping information across town and across the sea, is changing our world. What once was the realm of military scientists and MIT computer geeks is now accessible to king and commoner alike. The Internet savvy know how to quickly retrieve daily stock information, find a movie review and learn a thing or two about chronic fatigue syndrome. It's getting to be that if you're not wired, not on-line, if you're not cybernating then you're technologically hybernating.

"We recognized early on that the Internet was going to be a powerful tool," says Judith Messerle, Countway librarian for the Harvard Medical and Boston Medical libraries. "As soon as it opened, we knew we were going to play."

Located on the lower level of the Countway Library, out of sight from the journals, books and copy machines, is the command center for HMS's gateway to the Internet: the "server"—a Sun Spark 10 Unix system with 7 gigabytes. (In cybermetric, 1 gigabyte equals 1,000 megabytes.) The server literally serves as the relay station for HMS's connection to the World Wide Web—the Internet interface filled with pictures, voices and quick links to a world of information. It hosts the HMS home page (a "home page" is the welcome mat to a whole series of information about the institution and related subjects) while providing support to users from all over the world who visit Harvard Medical School online; and also connects everyone at HMS to their own on-line world travel. The server is like the heart, taking in and passing out blood cells of information. If the server goes down, the heart stops, and well, you know the rest.

It's taken only two years for Countway to amass this level of heavy-hitting computer power, but, says Tim Fox, system administrator at Countway who commands the server, as more and more people "hit" (Internet lingo for "visit" or read) the

HMS home page, even this intense amount of horsepower is strained. In just one month in 1995, 600,000 files were downloaded from the HMS site.

"We're now the public face online," says Messerle.

Elizabeth Wu, assistant director for planning and systems at Countway Library, was the first to recognize the Web's potential for Countway and for the school. "It instantly provides access to the global community," says Wu. "The user will now find you instead of you trying to find the user."

Not only does the World Wide Web make it easier for an alumnus in Switzerland to know what's happening with his alma mater, but also people from less privileged countries or communities in the United States now have access to Harvard libraries—a phenomenon rarely, perhaps even never before possible.

"It equalizes everyone," says Wu. "You used to have to come to Harvard; with the World Wide Web, Harvard comes to you."

The World Wide Web can be thought of as an electronic book with an infinite number of pages. Unlike those with embossed spines sitting on shelves, however, World Wide Web pages are a combination of text, color pictures, sounds, moving pictures and even three-dimensional images. Like Prospero's books in *The Tempest*, these pages may even at times seem magical, holding vast amounts of information and maybe even a few secrets.

The most vivid example coming from HMS is the "Whole Brain Atlas" by Keith Johnson (see sidebar). As part of this site, a movie shows, in quick succession, the lesions that appear over a span of time within a multiple sclerotic brain. "Something like that just doesn't exist in print," says Wu.

Because the Web so dynamically exceeds the limitations of the printed page, particularly in regards to producing clinical and research information quickly, on-line journals are becoming popular sites. Also linked to the HMS home page is the *DJO*, or *Digital Journal of Ophthalmology*. Edited by Frederick A. Jakobiec '68, Henry Willard Williams Professor of Ophthalmology, the *DJO* is a peer-review journal that operates similarly to a print journal: it accepts both clinical and basic science topics, includes a presentation of grand rounds cases and original articles. It distinguishes itself, however, in its use of an interactive knowledge review that is updated weekly and a section on patient information, where the lay person can learn about common eye diseases, such as cataracts.

The HMS page also links to the more traditional "paper" newspieces, such as on-line versions of *Focus* and selections from the Harvard Health Publications Group. Even this issue of the *Bulletin* is up on-line.

Just as a caller to the main telephone switchboard at HMS is connected to the correct department, so does the HMS home page link to places in and around and affliated with Harvard, such as BrighamRad, an in-depth look at the Department of Radiology at Brigham and Women's Hospital. The department's chairman, Leonard Holman, Philip H. Cook Professor of Radiology, calls the Internet an "idea in evolution" and

Click Trip Through the Brain

The computer wizardry of the World Wide Web, with its "hypertext" jumps to other sources of information, moving pictures, even sound, is an extraordinary departure from typewritten text on a screen. But at its basic level, the Web is a "useful tool" for someone like Keith Johnson, an HMS neurologist at the Brigham and Women's Hospital, who is co-creator of one of the most exciting medical sites on the Web.

The Whole Brain Atlas—which Johnson created with J. Alex Becker, a physicist and software engineer at MIT—is a mixture of normal anatomy and physiology of the brain with case-based examples of brain imaging seen in diseases. It has a time-lapse movie of a brain undergoing acute stroke due to embolism as well as a one-of-a-kind data set of images of the brain in which you can observe the lesions of multiple sclerosis coming and going over time. It lists the top100 brain structures and quizzes visitors to name these structures.

There are imaging data sets (using MRI, CT and nuclear medicine) for 25 neurological diseases, which Johnson plans to expand to 100. "Our goal is to build a reference library of neuroimages," he says. It won't be on paper or even on film; it will only exist on the Internet.

In only five months after they started counting in August 1995, there were 69,924 visitors to the Whole Brain Atlas (http://www.med.harvard.edu/AANLIB/home.html). But when Johnson and Becker started this project two years ago, the Web was in its infancy. What prompted them to spend a lot of time on something few others, at least in the Harvard medical area, were doing?

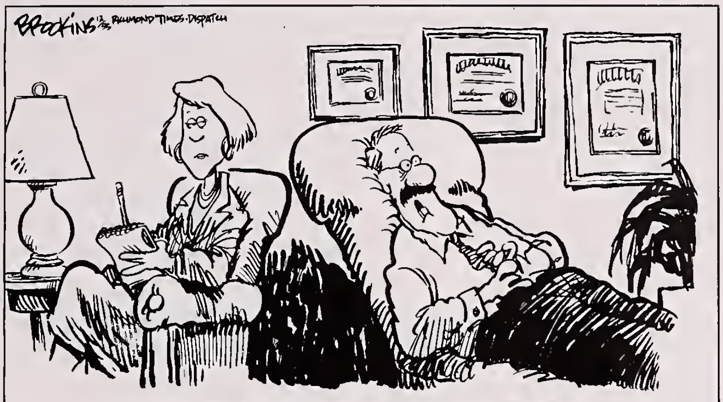
"My research has to do with image processing," explains Johnson. "We saw the Web with its potential to use images and text as an opportunity to make some of our results of image processing techniques available to medical students, neurologists, neuroradiologists, neurosurgeons and neuroscientists."

Johnson and Becker had found a solution to the problem of image registration, the alignment of body images in space so they match from one time point to another. "We look at the brain in slices and if you don't slice in the same way each time, you can't compare one time to the next or one kind of brain image to another," says Johnson. In developing their image-registration software called Superpose, they had accumulated lots of brain images, plus

looks to it to provide "innovative solutions to in the rapid dissemination of information about changes in technology."

Web "surfers"—surfing is the trendy term given the act of clicking from home page to home page—on the HMS page can also link up to the Department of Cell Biology. On a page of all the faculty in the department, click on his photo and you'll discover that John Blenis, associate professor of cell biology, is working on a project to understand how "two protein phosphorylation cascades are modulated by growth in several different cell types." Click again and you'll get a description of MAP kinase/RSK signal transduction.

Inside the Department of Genetics, besides getting necessary information about the lab research happening there, you can also discover that graduate student Jason Johnson likes to fish, play Ultimate frisbee and listens to David Wilcox. Grad student Cory Kostrub's page leads you to the weekly menu for the Chinese food truck



" DOCTOR, I FEEL SO INADEQUATE ... I ... I DON'T HAVE A WEB SITE ... ! "

parked outside Vanderbilt Hall at lunchtime.

On each page in this colorful cyber-book called the Web are lines of text that are underlined. Called hypertext links, they work like a set of Russian nesting dolls, revealing doll after doll. Click on one and another doll, or page, is revealed. Click on a piece of hypertext on that page, and another page comes up.

Many pages include a category of hypertext lines called "Web Jewels." Click here and one can find a virtual treasure chest of biomedical information, such as the Bioethics Online Service from the Medical College of Wisconsin to GASNet, the Global Anesthesiology Server Network, to a tour through the workings of the heart. Many pages from HMS even link to ones describing life in the Boston area, which include restaurant reviews, information on city government and the scoop on how to find a hotel room during the Boston Marathon. (For those who need it, a real gem is the BBN Auto Body Repair page. It lists

Johnson had neurological disease cases he had collected through the years.

"We had no idea if people would be interested in these images." As it turns out, people from a large range of disciplines have "visited" their site: from education, publishing, pharmaceuticals, NIH, psychology as well as from the neurological disciplines they had expected. It was designated one of the top 5 percent sites of all sites on the Internet by Point, a service that surfs the Internet and reviews the most noteworthy sites.

As Johnson modestly explained the probable reason for this distinction: "We've had a lot of favorable comments about our use of hypertext navigational tools. When reviewers came upon it, they might not have known about the brain, but they could see the value of these tools we developed."

The two time-lapse cases have been particularly well received. "We've designed into the Atlas the ability to take a guided tour through different brain slices to see pertinent findings," says Johnson. "Certain things are best demonstrated by movie, that is, rather than moving your eyes past a series of data, keeping your eyes in one place and changing the data."

In the case of the acute stroke due to embolism, by clicking on a key on the screen, you can see how a lesion evolves over time, in this case five days. In stroke, the brain swells as it accumulates water and you can see it get so swollen that everything gets pushed around.

Because of image registration, says Johnson, the multiple sclerosis time-lapse movie is one of their most advanced data sets, representing 23 cases over a year's time. You can click on the "time" button to look at a single slice over time, or change the plane you're viewing from by clicking on the "space" button. There are ways to navigate through about 1,200 slices. Click the spatial button and look at images that depict the entire brain on one given day, or "ciné" in the time domain and see the lesions come and go over time.

"What this tells us is that lesions of MS come and go but not in synchrony with each other," says Johnson. "It was known that lesions come and go, but because of the time-lapse aspect, this tool allow us to see that the lesions are out of synch and to observe the lesions change in the same part of the brain." In the quest to find a treatment for MS that will rid the brain of all lesions at the same time, this tool will be an invaluable window.

At this point, Johnson spends very little time on the Whole Brain Atlas. He is soliciting contributions from researchers with other disease data sets

shops in the Boston area and a few years' worth of invaluable comments from customers.)

By one route or the other through these links, the HMS home page connects to the NIH, the National Institutes of Medicine, the Centers for Disease Control and the World Health Organization.

So while there's plenty of good information to be found on the Web, obviously, it doesn't take long to leave the halls of medicine and enter the whacky and off-beat. Somehow a surf through the HMS home page mysteriously calls forth a page for Chocolatier's Best Brownies, complete with a picture of delectable-looking brownies and a recipe for chocolate chubbies. Unfortunately, though, just because they look and sound good, and because the Chocolatier home page looks like it was designed by a professional baker, doesn't mean the chocolate chubbies necessarily taste good. The same applies to medical information or any other kind of information found on the Web.

"Just because it says medical doesn't mean we point to it," says Jean Charbonneau, a knowledge and consultation services librarian at Countway. His job is finding interesting and informative Web sites and creating links to them from the HMS home page. "There is a lot of junk but also a lot of good information that you wouldn't find anywhere else," he says of the growing amount of medical information on the World Wide Web.

But finding the good stuff isn't easy. It means surfing for hours at a time and sorting through oftentimes poorly organized search engines with unsophisticated categories. As more and more sites enter the Web every day—estimates for the number of daily users is in the millions—"just keeping up will be a challenge," says Charbonneau. And finding a good site is no guarantee it will stay that way, say those who spend a lot of time looking for them—a particularly dynamic challenge for librarians looking for Web "acquisitions."

"If we buy a book and put it on the shelf, we know what is in it," says Wu. "But with a link, today the content looks alright, but someone could change it tonight and we wouldn't know."

The other beguiling aspect of the Web is that anyone with time, a computer and the knowledge about how to make and put up a Web page can create a site containing medical information, whether that information is right or wrong. There's no regulatory board overseeing Web content, no electronic form of the framed MD to hang on the wall. Wu says the scariest thing she's seen thus far were instructions on how to handle a choking victim: "Who put that up there?" she wonders. And, who will read it and try it and who may choke to death if those instructions are wrong?

Wu says that she and the other information specialists at Countway employ similar peer review standards for linking Web sites to the HMS home page as they would to putting a book on the Countway shelves. For example, if a site is developed by a known organization, such as the CDC or the WHO, she says, then they "feel confident that it's good."

Internally, several departments have soared way ahead of others and purchased their own servers. As the technology becomes more sophisticated, says Fox, "you can run a web server on just about any platform," and many departments have done that, including genetics and cell biology.

Others departments, however, have put up barely more than the name of their chairperson and their address.

The Countway would like to get everyone on the Quadrangle up online and the people at Countway help them accomplish that by showing them how to build a page. After that, it's up to individual departments to maintain their own. The quality of each department's page varies considerably.

"They develop it incredibly well, or it's in total disarray," says Charbonneau. "We just provide a link."

As word gets around and more peo-

and plans to establish a peer review process to monitor submissions for technical as well as pedagogical content and interest. The contributors' raw data will be registered using the software he and Becker developed.

The use of the Web in medicine is still in its infancy, points out Johnson, who says it is not clear precisely what needs it will satisfy. "But it will certainly create new needs."

Aside from the advantage of displaying imaging data, he personally finds other resources on the Web useful. "There are an increasing number of useful tools in neurology and radiology, such as subspecialty updates and constantly revised electronic textbooks. It is a continuing education tool as well as a handy reference."

Though Johnson had no idea what impact his "page" would have when they started, he says the response has been gratifying. As he points out, there are places in the world where this information is hard to come by, not just in developing countries but in other hospitals in the United States. And though no one is sure what role the Web will ultimately serve in academic medicine, let alone in the world at large, as Johnson puts it: "The potential is astonishing."

Ellen Barlow

ple and departments want to go on-line, ideas about how those pages should look and what kind of content they should have need to be considered, says Wu. She and others will be forming a committee to discuss what the HMS on-line face should look like.

"Internally, we're working on policy to figure out a way to present our own material to the world," says Wu. She explains that they want quality control, but without incorporating bureaucracy to inhibit each department. One issue will be the use of the Harvard seal and logos. For example, Wu says she wouldn't want to see a department put up a rainbow-colored seal. "Instead of everyone just inventing things, we need to set guidelines," says Wu.

So what does the future hold for the Internet world? "I can safely say that the Internet is here to stay," says Charbonneau. "It's not a fad."

With projections that the paper versions of medical publications, such as the CDC's MMWR, will soon be replaced by electronic formats and with more and more popular journals existing only in electronic versions, the potential for the Internet's future in medicine are multifold. That, in conjunction with a proliferation of on-line support and information groups for every imaginable disease and disorder (the MGH Department of Neurology, for example, hosts on-line discussion groups on Guillain-Barré syndrome and early-onset Parkinson's disease, among others), patients' ability to gain pertinent information is determined only by their ability to read and type and their understanding of the technology.

For those just waking up to this brave new world, Wu has some advice: "You need to get your feet wet," she says. "Be like a kid who's not afraid of anything. Just click, click, click!"

Terri L. Rutter is associate editor of the Alumni Bulletin.

Getting Started

First off, you need a computer, and just about any computer will do—that's the equitable beauty of it all. So, whether you're a Macintosh person or you're determined to never use anything but DOS, you're still on. If you've got an older computer already, you may need a memory upgrade if you want to be able to see all the fun graphics on the 'Net. The operating systems of new computers should be Internet-ready—ask your dealer.

Then you need a modem. Higher-end computers will have built-in modems, or they can be purchased as separate components. Again, if you want to download pictures and graphics, you'll need a baud rate (the speedometer, in a sense) of at least 14.4K bps (bits per second) and if you're really in the mood, get a 28.8K bps. For text only, however, a 2400 bps will suit you fine.

The next requisite purchase is a subscription with an Internet connection service if you don't already have access through a university. America Online and CompuServe are the biggest national services. They each offer access to the Internet (although there are some restrictions) and each also has an "interface" of its own that includes links to information on a variety of subjects, as well as chat rooms, where people can speak to each other on subjects they have in common. AT&T has just released an Internet package available to all its long-distance customers (MCI and Sprint are on its heels with their own), and Microsoft, too, has a package.

These companies offer a way to surf the 'Net, but you'll have limited opportunities to look at the Web. For that, you need a more direct connection such as those offered by Internet service providers (ISP), of which new ones are popping up all the time; some are national and others are local. For example, in Boston TIAC (the Internet Access Company) has offered a deal to HMS faculty, students and staff. Check your yellow pages or pick up a copy of a computer magazine, such as *Wired* or *Internet World*.

To view the World Wide Web, you'll also need a "browser" such as Netscape or Mosaic, which can be downloaded straight off the Web, or the ISP will include a browser in its start-up software.

There are several good guides to using the Internet, the most basic being *Internet for Dummies* (don't take it personally!). It's available in the computer section at any bookstore. There's also an on-line guide for working your way through the Web: http://www.eit.com/web/www.guide/. Closer to home, the webspinner for the MGH Department of Neurology, John Lester, has an easy, fun walk-through guide: http://demOnmac.mgh.harvard.edu/, then click on *Help Me*.

Once you're on-line, you can find a variety of medical information, both academic and offbeat. A good place to begin might be the Harvard Medical School home page: http://www.med.harvard.edu. If you want to go elsewhere, click on Web Tools and you'll find lists of links to a variety of places and subjects. Or, you can access some of these places directly using the following URL addresses. Happy clicking!

- National Institutes of Health
  http://www.nih.gov
- National Library of Medicine
  http://www.nlm.nih.gov
- Centers for Disease Control and Prevention
  http://www.cdc.gov
- U.S. Medical Libraries List
  http://www.kufacts.cc.ukans.edu/hytelnet_html/USOOOMED.html
- WWW Virtual Library: Medicine
  http://golgi.harvard.edu/biopages/medicine.html
- The Visible Human Project
  http://www.nlm.nih.gov/extramural_research.dir/visible_human.html
- MMWR
  http://www.cdc.gov/epo/mmwr/mmwr.html
- Department of Health and Human Services
  http://www.os.dhhs.gov/
- World Health Organization
  http://www.who.ch/
- Food and Drug Administration
  http://www.fda.gov/

TLR

Operating in 3-D

by Ellen Barlow

Virtual reality is virtually here, at least in one operating room at Brigham and Women's Hospital. As a patient lies in a revolutionary open-design magnetic resonance (MR) scanner, the surgeon is guided through layers of tissues by real-time 3-D images. He or she can virtually "see" the blood vessels and tumor volume beyond the surgical field just by looking up at a monitor.

None of this would be possible without the computer. It is computer-assisted technology, a simple term that belies the complexity of an undertaking that has made real-time image-guided surgery realistic and fast enough to be reliable.

This surgery also would not have been possible without the vision of Ferenc Jolesz, HMS associate professor of radiology, whose brainchild the open-MR scanner was. He persuaded General Electric to build the prototype, which has been in experimental use at the Brigham since 1994. It has been used for abdominal procedures and, since last summer, neurosurgeons have performed brain biopsies with their patients lying inside the scanner. The first open-brain procedures began in February 1996.

Jolesz, director of the BWH's Division of Magnetic Resonance and of the image-guided therapy program, and Ron Kikinis, HMS assistant professor of radiology and director of the BWH Surgical Planning Laboratory, have been working on the technological challenges of image-guided surgery the past six years. Diagnostic MRI produces beautiful, high-resolution images, but they take a few hours to process. Only in the past year have the Brigham and GE researchers made enough progress on some of the scientific and engineering challenges that the intraoperative imaging process has been fast enough and resolute enough to be useful during surgery. Plus, because of the magnetized environment in the special open-MR operating room, the anesthesia machines and every one of the thousands of surgical steel instruments are being tested and if necessary, redesigned to be compatible.

The concept of using imaging as a direct means of therapy is not new, points out Jolesz. Surgeons and interventional radiologists have been using ultrasound and fluoroscopy for real-time imaging for many years, but these methods yield limited, imprecise tissue information. A more recent method uses CT and frame-based stereotactic guidance, plotting with grids, but these are previously acquired CT images and lack the real-time dimension necessary for making continual adjustments.

"Generally the way surgeons have worked over the past 100 years is to come down to radiology and look at films," explains Jolesz. "They either just remember a mental image of it or take the film to glance back at. But it is just one cut, not a three-dimensional view."

There is inherently more information that radiology can provide the surgeon, the actual coordinates of the target, for example. But until recently, "The images weren't being used as a roadmap, because they were not presented in a way that the surgeon faces in the real world, that is, as 3-D structures," says Jolesz.

Jolesz, who was a surgeon in Hungary before coming to the United States and retraining in radiology, further describes the visual frustrations that surgeons face. "The problem with surgery is that we are using a human's visual information, light reflected from a visual surface. You put one piece of paper under another and you can't see the one underneath.

"This is the same problem a surgeon has. If there is a deep-seated tumor, you have to go in to see it. The target is a volume—say, cherry-sized—but you have to make a large incision and peel back layer after layer of tissue. If there are blood vessels under one surface, you get bleeding if you didn't see them."

Surgeons want to follow the old principle of making the smallest incision possible so as not to hurt the normal tissue, he explains, but they have to be able to visualize the whole lesion. Visualization is particularly limited in minimally invasive surgery, a trend in recent years to use endoscopy and "keyhole" surgery to reduce access damage. "You may be in the stomach, but you don't know what's at the other side beyond the hole," points out Jolesz.

These are the spatial limitations of surgery, he says. In efforts to minimize these limitations, the field of image-guided surgery was born five or six years ago.

The germination of Jolesz's vision for an MR image's role in all this actually goes back a little further. After doing a stint in the physiology laboratory of Elwood Henneman in 1980, Jolesz decided to stay in the United States. Faced with repeating training in surgery, he decided to train in a new specialty, radiology. He started working with MRI when it came to the Brigham in 1986, where he was by then working. Around this time, he recalls, he went to a party and struck up a conversation with an ENT surgeon, who mentioned he was using laser surgery for tumor treatment.

"I questioned him about it and asked him why if he could cut and heat the tumor, he couldn't go deeper inside the tumor fiberoptically through a needle. He said it was because you can't see what the hell you're doing. If you use too much energy, you burn other tissues; too little and it doesn't help. I mentioned that one of the parameters of MR is that you can see heat."

The idea planted, Jolesz did experiments in 1987 and found that image-guided laser surgery is possible. That led to the development of a technique for thermal ablation of tumors under MR-guided focused ultrasound, that is, real-time image-guided, high-energy heating in a focused point. They found that cryosurgery also can be guided by MR.

Then he began to think about other ways to generate intraoperative

images. MRI struck him as the perfect modality: it provides excellent tissue contrast, often with enough definition to allow discrimination between lesions that need to be treated and those that don't; it was seemingly possible to generate three-dimensional images; and the imaging sequences could potentially be made fast enough to allow real-time viewing of physiological motions.

He envisioned the adaptation of MR technology to an operating room environment and sold General Electric on the idea. GE was producing CT, ultrasound and MRI scanners and Jolesz was able to convince their executives that this was a whole new market, not just a shifting of business from one piece of the diagnostic-imaging pie to another.

Their executives made a site visit. "They could see millions of dollars worth of imaging equipment in radiology—each piece costing $1 million and each with advanced computer technology," he recalled. "Then they visited the operating rooms. What did they see? Clean rooms with tile, a table that could go up and down, a big lamp and maybe a few thousands dollars worth of electrocautery or laser equipment. Very low-tech."

GE built the prototype and developed the necessary computer software, in collaboration with the BWH group, and has spent about $30 million to $40 million on the project thus far. The open magnet looks like a conventional MRI with a middle section cut out. The patient lies in the tunnel, with the part of the body to be operated on exposed in the open, middle section, where the surgeon or interventional radiologist can access it. For neurosurgery, there are special, flexible coils shaped like a figure eight that wrap around the head.

Images are continuously generated every one to ten seconds as the operation proceeds, and are superimposed and automatically registered with images taken by a video camera aimed at the operating field. The surgical field may be bloodied, but the operator can look up at the monitor and see a 3-D, slowly moving picture of exactly where his or her instruments are, and can check and plan the course.

"Even if you're only looking through a small hole and can't see anything with the eye," says Jolesz, "when you have an imaging system like this with an MR image of a corresponding field, unbelievable things can be done. There are all sorts of applications."

Though Jolesz believes that the open MR with active imaging would be the ideal way to do all surgical procedures, it is very expensive at this point and requires specially designed equipment and operating suites. Another project he and Kikinis have been working on is done in conventional operating rooms but uses MR and CT images, which are obtained and made three dimensional before the operation, and then during the procedure are superimposed on the image taken of the surgical field by a video camera. This also provides a roadmap, says Jolesz, though is less ideal than real-time images. If there has been bleeding or swelling since the pre-op image was taken or if organs shifted even a centimeter when the patient was opened up, accuracy is compromised.

This method has been used thus far

on over 100 brain surgery patients, for whom this drawback was not a concern but accuracy was critical. Advanced registration and "tracking" techniques developed in Kikinis's lab—in collaboration with Eric Grimson from MIT and the neurosurgery division of BWH—provide neurosurgeons with three-dimensional image guidance, just without the real-time interactional capabilities of the open MR system. But as with neurosurgery done in the open-MR system, planning the procedure can be done without the less-precise stereotactic approach of using grids applied to the patient's skull, which are then imaged.

Though surgeons and interventional radiologists are using the open MR and preoperatively-obtained image methods, explains Kikinis, extensive resources are required. Their ultimate goal is still pie-in-the-sky, a few years away: to bring a patient into the open-MR scanner, push a button, have the computer crank out an image which it automatically makes 3-D, which the operator finds useful at a glance. Though major breakthroughs have been made in his lab, there are algorithmic and computational challenges that remain.

The challenges fall into four major areas, which Kikinis has approached in tandem with each other, "picking projects that will help us drive this development." The lab is housed in a clinical environment so projects they pick have had applications to schizophrenia, multiple sclerosis and aging studies. "We are using clinical problems to drive technology development," says Kikinis. The four technical areas under development are:

- Segmentation, the capability to automatically produce clinical information out of the data, identifying structures of clinical relevance. This is the first step of the process that renders the image 3-D. Though parts of the process are now automatic, Kikinis says they'd like the whole process to take no more than five minutes rather than a total of thirty minutes to two days.
- Registration, to exactly align the 3-D data information with the corresponding anatomy of the patient. The result is structures as seen in virtual reality.
- Tracking, done by different methods: using video cameras, LEDs (light emitting diodes) or electromagnetic devices. Tracking of surgical instruments is necessary to get the image at the point where the operator is working.
- Visualization. If they solve all three of the above problems, says Kikinis, then they need to decide how to ultimately and efficiently present the total picture.

"So we have a palette of techniques and each project we do is like a painting that uses different techniques to get results," says Kikinis. "Our long-term goal is to widen the palette and make it more robust." Right now they have segmentation processes that may work with their multiple sclerosis project but not easily with other data sets; or processes that work with normals, but not in tumor cases. "We want algorithms that will work in any case, that are robust enough to handle different resolutions, different pathologies."

Their projects are seemingly disparate, but all are centered on the core technology of computerized post-processing of diagnostic medical imaging data. Right now this is all very high-entry research, says Kikinis, involving multi-million dollar equipment and lots of people. "But in the long run to be meaningful it has to be beneficial not only to a few patients in research hospitals but to every patient who might benefit."

Automation is so important because it reduces the number of trained people who have to be involved and makes the process faster. A leap forward in the effort to automate was made last fall by a computer scientist in the lab, William "Sandy" Wells, who with Paul Viola, a graduate student in MIT's Artificial Intelligence Lab, came up with an elegant algorithm that renders the video-based tracking technique fully automatic.

"With a person involved there is only so much you can do to speed up the process," says Kikinis. "Every year computers get 1.5 or 1.8 times faster, so if there's an algorithm that automates, as computers get faster, the process gets faster." Speed—both in processing and in acquisition of data—is the name of the game if the images are to be useful in real-time.

In the meantime, the experimental use of the open-MR operating environment is expanding. Open-brain surgery just began at the Brigham. Hospitals in 15 other cities around the world—including Quebec City, Zurich and Palo Alto (Stanford)—will soon be receiving and using these machines.

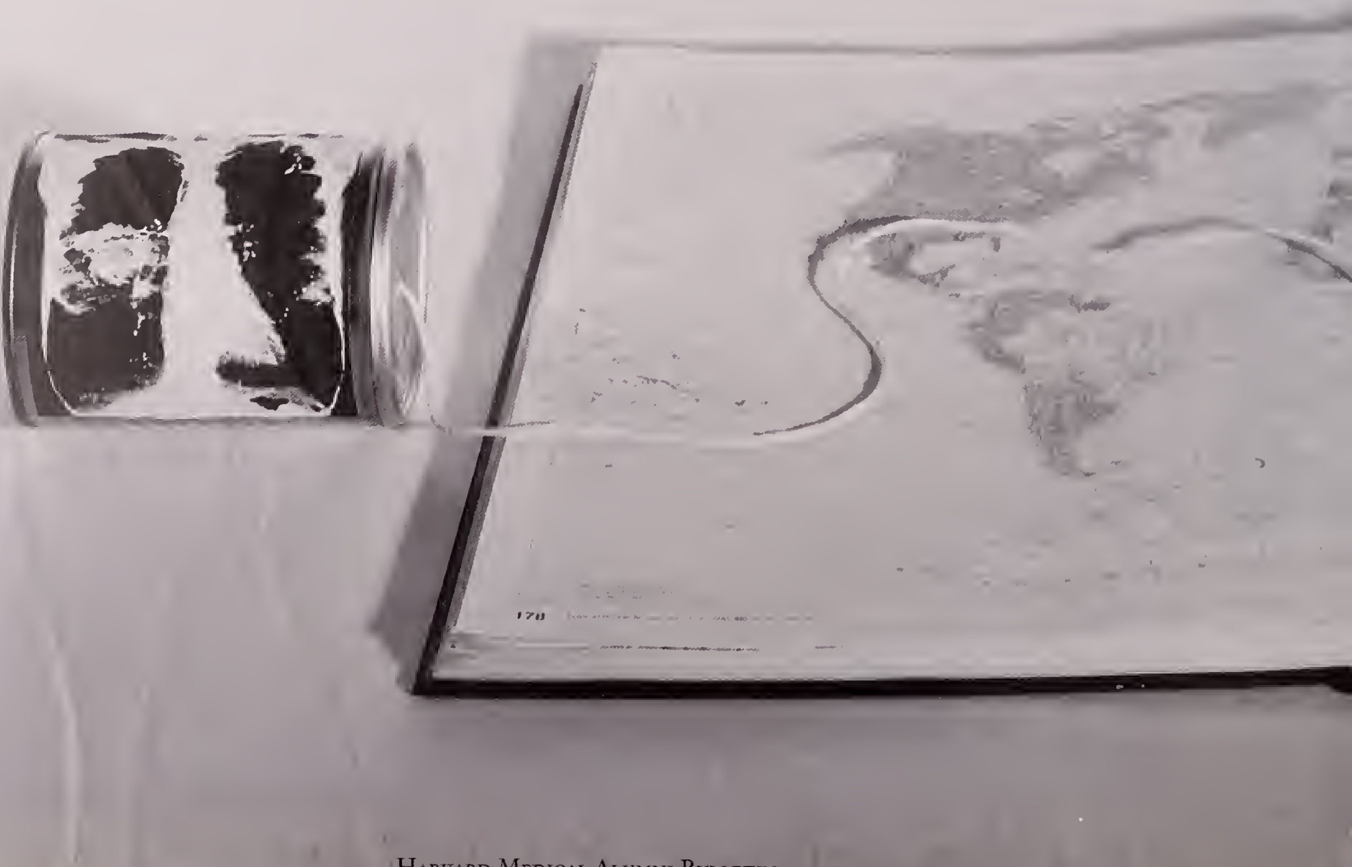
But whether we'll be seeing suites of open-magnet operating rooms in the future remains to be seen, says Jolesz. One thing he knows for sure: "Without computers all of this would have been impossible. I could dream of it, but it couldn't have been done."

Ellen Barlow is editor of the Alumni Bulletin.

Tel-a-Doctor

Terri L. Rutter

Telemedicine technology makes the far-reaching diagnosis of a lung mass as easy as child's play.



TELEMEDICINE SOUNDS LIKE SOMEthing you do alone in your room with a telephone, a mysterious symptom and an 800 number. Indeed, telemedicine is that, but it is also so much more.

Telemedicine has been defined as the "investigation, monitoring and management of patients and the education of patients and staff using systems which allow ready access to expert advice and patient information, no matter where the patient or relevant information is located," by the Commission of the European Communities. Basically, telemedicine is employed when a patient is in one location and the physician making a diagnosis, interpreting a film or just offering an opinion is someplace else—next door, in the next county, or in another country. The means by which the physician communicates his or her medicine, the "tele," can be a telephone or fax, electronic mail, or something much more complicated, such as sophisticated real-time videoconferencing equipment.

A group of forward-minded physicians at the Center for Telemedicine at Mass. General Hospital are devising means of interfacing communications technologies with medical practice in practical ways that save time and money, and exotic ones that link patients from as far away as Riyadh, Saudi Arabia with specialists at MGH.

"Telemedicine is creating a global medical village," says James Thrall, chief of radiology at MGH and an early champion of telemedicine's potential. MGH specialists in 25 departments—over 50 physicians—have been involved in more than 300 case management consultations internationally, including Saudi Arabia, Moscow, Mexico and Latin America.

The telemedicine concept itself is really very old, perhaps going as far back as the first phone call ever made—itself prompted by a medical emergency. In 1876 Alexander Graham Bell made the first 911 call after spilling acid on himself and cry-

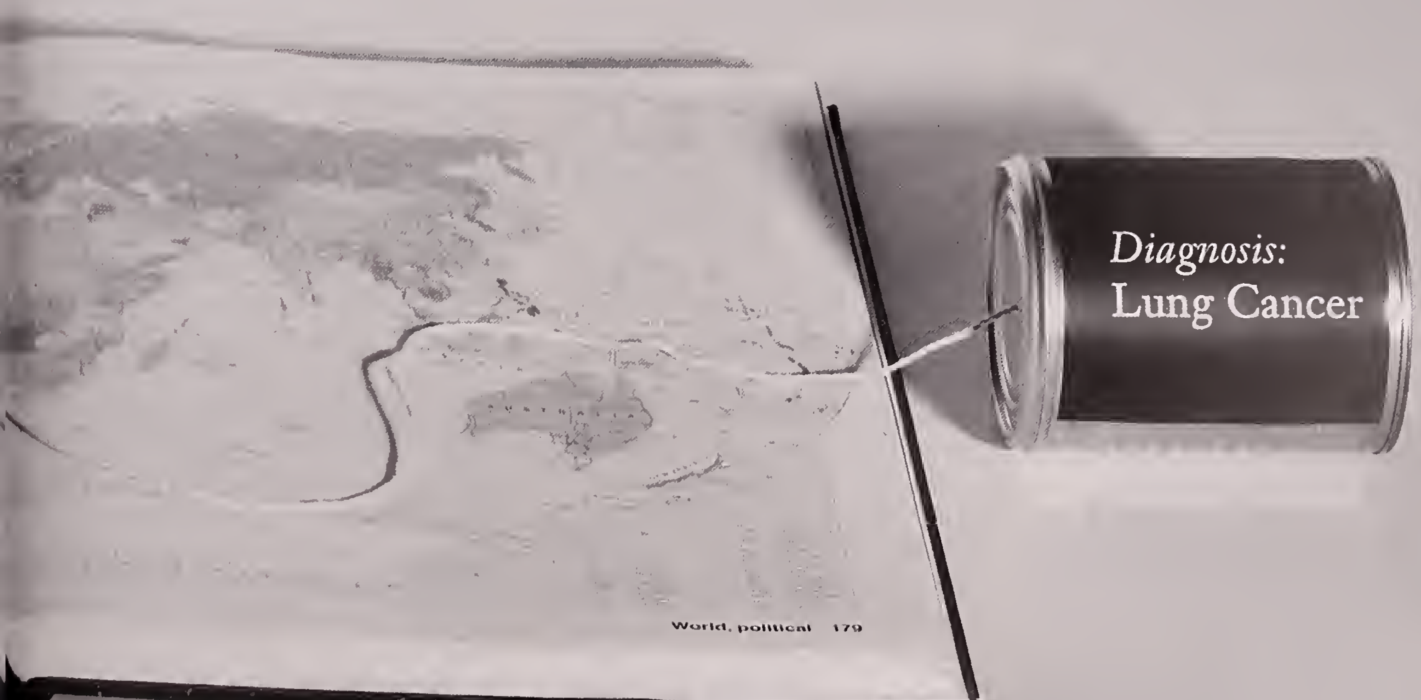


photo by Stuart Darsch

"Telemedicine is creating a global medical village."

ing out to his colleague through his newly invented transmitter: "Mr. Watson, come here, I want you."

Efforts to send medical information through a technological medium at MGH go back a long way as well, to 1967 when Kenneth Bird collaborated with Thomas Fizpatrick and the Raytheon Corporation to use a microwave video link and closed circuit television to connect the MGH with Logan Airport. Although short-lived because of the limited technological capacity available at the time, this team was able to transmit black and white radiologic images and carry out projects in cardiac auscultation, physical diagnosis, telepsychiatry and speech therapy.

In more modern times, Joseph Kvedar, assistant professor of dermatology and medical director of the center, believes the development of tele-specialties will create ways to provide the often necessary expertise of a specialist while saving the cost of expensive face-to-face office visits. Just last year, for example, Lee Baer, associate professor of psychology in the Department of Psychiatry at Massachusetts General Hospital, conducted a successful pilot in telepsychiatry that screened for depression. Using voice-mail technologies, callers at two Midwestern sites were asked to respond to a series of comments, such as "I have crying spells or feel like it," and then directed towards appropriate information about where they could turn for help.

Within managed care situations, specialists are often regarded as a rarely used commodity, says Kvedar. But patients are used to seeing, and expect to see, a specialist. Telemedicine, therefore can provide an integrated system of care. "The more mergers that happen, the more important the use of this is," says Kvedar, who is leading a project at the center to study the feasibility of tele-dermatology.

Ideally, the future of the MGH Telemedicine Center could look and operate like this scenario: A hypothetical patient, say in Norwood, asks his primary care physician about a mole he has just noticed. The primary care physician thinks a dermatology referral is a good idea but his patient is older, doesn't drive and can't get a ride to Mass. General to see a dermatologist until three weeks hence. In the meantime, he's worried and the physician is concerned the mole could be malignant.

Using a highly sophisticated digital camera—which would be provided to all affiliated primary care offices—the primary takes a digitized photo of the mole, then transmits that image to the dermatologist's computer at the center. At the end of a day, the dermatologist sits at his office computer and enters his referral file folder of images. He clicks on the Norwood primary care physician's file and sees a high resolution image of the mole. Beside the image is a text file of the patient's history and all other relevant information. The dermatologist can assess the mole, determine whether it needs a biopsy or decide if he should meet with the patient to see the mole itself. He types in his thoughts and sends them back to the primary care physician, who can retrieve them the next morning and call her patient with the specialist's recommendations.

"Telemedicine allows the primary physician to do the things patients are uncomfortable doing with someone they don't know," says Kvedar, who cites the examples of talking about difficult issues or disrobing for an examination. Yet it provides for "a better interpretation than the primary care physician will have, and at less cost to the patient than meeting with the specialist personally."

The telemedicine concept itself is really very old, perhaps going as far back as the first phone call ever made.

There are problems, however, with this picture.

"Right now the technology exists, but it's not fully deployed," says Kvedar. The center currently supports video conferences and satellite downlinks for consultation, CME and business meetings.

Radiology services, on the other hand, are handled in conjunction with a company called American Telemedicine, Inc. ATI's roots are in the radiology department at MGH—Thrall was one of its founders—but the organization struck out on its own in 1993. Radiologist Mark Goldberg was on staff in the department and now directs ATI, which has recently been acquired by the Dutch company WellCare Holdings, NV. ATI is involved in many projects promoting both the use and the advancement of telemedicine nationally and worldwide.

Radiology is so advanced, explain Thrall and Goldberg, because radiology images were already digitized when the electronic telecommunications technology became available that could transmit digitized images. This specialty distinctly stands out, however, because radiologists have the luxury of being reimbursed for any film they read no matter where it was taken and no matter where they actually read it, excepting a few states. Other spe-

cialists are not so fortunate. Currently, insurance payers won't reimburse telemedicine "visits"; every other specialist has to see a patient face-to-face in order for it to count.

Licensure and liability are other issues to be worked through if telemedicine is to have a future. If specialists aren't licensed in a state, and therefore are unable to practice medicine in that state, can they offer an opinion on a patient in that state via telemedicine? If it turns out to be a wrong opinion, resulting in a bad outcome for the patient, can remote physicians be sued, and in what state are they liable: the state in which they practice, or the home state of the patient? Also, the FDA is involved, as telemedicine technologies are considered medical devices.

Historically, much of this has been inconsequential because internationally, where telemedicine is most prominently used, licensure and FDA approval aren't issues. In the United States, institutions that have relied heavily on telemedicine, such as the military and the federal prison system, are also not confined by licensure and liability issues. Telemedical projects have also been explored to serve underserved rural areas, where the nearest specialist may be hundreds of miles away.

Thrall, however, keeps all the snags in perspective. He recalls the days when traditionalists absolutely scoffed at the idea of transmitting medical information over the telephone—telemedicine's first technology.

"I see telemedicine as a natural extension for health care in the electronic age," he says. He points to what has been called a "one-world" concept, whereby the fields of banking, with ATMs all around the world, news coverage whereby CNN has a port in every town and city world-wide, and rapid-fire telecommunications are all contributing, indeed creating, an integrated one-world community.

"It's medicine's turn to take advantage of this revolution," he says.

Terri L. Rutter is associate editor of the Alumni Bulletin.

The Digital Clinic

by Luke Sato

"Multimedia" has come to mean many different things to many different people. In the strict sense, the basic elements of multimedia are text, graphics, digital video, audio, animation and still-images. A subset of these elements—mainly text, graphics and still images—have been used with computers from the beginning. Only in the past three years have we seen that most computers sold today also incorporate digital, video, animation and sound.

Multimedia PCs allow us to effectively combine these elements to deliver information more powerfully. Currently, paper-based cases are used in tutorial sessions within the core curriculum courses at Harvard Medical School. These cases are designed and developed according to the New Pathway philosophy of case-based learning methodology. Part of the impetus for such an approach is to offer students not only a clinical context, but also an incentive and a context for studying the basic sciences.

Having a "patient" with whom to associate their learning experience becomes a powerful motivation to study the physiology, anatomy, pharmacology and the pathology of the human body. This clinical context provides students with a focused approach to the material. In addition, the extrapolation of the case-based methodology used within the curriculum becomes the problem-based approach to modern clinical practice.

However, the use of paper-based cases has its limitations. When students are asked later about the details of a specific case, frequently they will have forgotten the case itself or have some difficulty remembering key concepts that were discussed during the case. In other words, there is a lack of distinguishing features that identify one case from another. Nowadays, students coming to medical school are exposed to programs like MTV and to computer and video games, which have stunning sound and graphics. Not only do the graphics and sound effects provide a means of catching attention, but they are also an effective means of communicating information, especially to the younger generation.

To maximize the efficacy of the case-based model and to greatly enhance their learning experience, students have been asking for more multimedia-based cases. In addition to fulfilling the goals set by the New Pathway, multimedia-enhanced teaching gives students exposure to as many "real-life" patients (cases) as possible. Adding a "face" to these "patients" through multimedia technology makes the cases come to life. Students will be able to experience clinical interactions that they may have little or no exposure to during the first two years of medical school.

To effectively communicate to students issues of how physicians care for dying patients, we designed a multimedia-based software exercise that allows students to analyze interactions between heath care providers and patients. The multimedia program described is based on this video and is also used in the course in conjunction with the video. Scenes within the video are incorporated into the multimedia program as digital video clips. This video was produced by Josh Hauser '95 and Lynn Peterson, associate professor of medical ethics in the Department of Social Medicine, for use in Peterson's Patient/Doctor III ethics course. It was used the first time this year and will be used again in Peterson's course next year.

In one scene, a woman in her sixties is admitted to the hospital for a hernia repair. She is later discovered to have metastatic ovarian cancer. This case is set in the woman's hospital room after her surgery. Scenes depicted show different caregivers talking with the patient; she is told of her diagnosis by her surgeon, a nurse, a medical oncologist and her primary care physician.

This program has the option to follow an individual caregiver or to examine a number of caregivers talking about similar topics with the patient. These digitized video clips portray different styles and manners of relating to patients, showing how each caregiver opens the interaction, how each closes it, how advice is given, or how each talks about future plans. Each topic is illustrated by digitized video clips excerpted from a videotape of the patient/provider interactions. The program allows close analysis of these interactions by placing them side by side for comparison. It provides ways of preparing students for clinical situations they may encounter in real life. With paper-based cases, this type of nontextual information is impossible to convey.

Faculty were closely involved with this project from the initial conceptualization. We experimented with this multimedia application as a facilitation tool for discussion among students. The program was arranged for display to a small audience of students, while a

Scenes from a Diagnosis: Students can click and follow how four different caregivers tell a patient she has metastatic ovarian cancer.

facilitator selected a theme from a menu of options. Students were later asked three questions: (1) What worked well? (2) What worked poorly? and (3) What would you change? In this example, multimedia elements, when used appropriately within instructional software, provided a more powerful means of communicating to students subtle nuances of the patient/provider interactions.

Just as different multimedia elements can be an effective means of communicating information to students when used in sophisticated instructional software, multimedia will help transform the ability for physicians to communicate with each other. As changes in health care gradually take shape, managed care plans like health maintenance organizations are restructuring their delivery of health care to a wider geographic area. One possible scenario for a patient might be for the primary care physician to send her to one health center to obtain a MRI and to another health center within the network to have a different procedure performed. Hospitals as we now know them will evolve to primarily intensive care facilities, while most diagnostic procedures, routine studies and follow-up care will be done at geographically dispersed outpatient facilities.

This type of health care delivery will lead to fragmentation unless the proper infrastructure is in place to provide for efficient and effective means of communicating among components within the network. Not only are there obstacles in communicating among components within a provider network, but also between the patient and provider as well as between provider networks. To compound the issue, the surge of information resources and data that the physician will need to assimilate has increased exponentially over the past decade.

As more and more health care providers turn to information and computer technology as a way of connecting various components within the provider network, multimedia will be used as an effective and efficient communication tool. Not only will multimedia become incorporated into the provider network system, sophisticated systems—implementing an almost problem-based approach used in medical school—will manage and access all multimedia-based patient information including lab reports, radiological studies, on-line medical references, electronic, video, and voice mail communications relevant to that patient.

Telemedicine will not only be point-to-point video conferencing so that specialists can consult each other. It will also evolve to include multimedia decision support resources, such as treatment and management guidelines, bibliographic references, images, video of patient findings, and radiology reports physicians need to have to make proper management decisions.

For example, considering our woman with metastatic ovarian cancer, in the future the primary care physician sitting at her desk could receive a video conference call from her patient. The physician instantly recognizes that the patient looks distraught. Initially, the patient denies any problems. However, as the physician presses her, the patient starts to break down and discloses that she is having difficulty making a decision whether or not to receive chemotherapy for her illness.

Her physician calls up the patient's medical record and issues a voice command to her workstation: "Please retrieve all material related to metastatic ovarian cancer." Instantly the computer retrieves all relevant information, including current statistics from a national ovarian cancer database comparing survival rates of patients with similar findings, patient-oriented educational materials, and several video correspondences she once had with the medical oncologist regarding treatment options along with attached bibliographic references.

Currently we view the Internet and the World Wide Web (WWW) as pro-

viding a far less sophisticated version of the type of interaction described above. However, we conjecture that the next evolution of the WWW will be able to provide true telemedicine capabilities. As multimedia-based cases give students an interesting, focused and efficient approach to studying the material at hand, future technology implementing a similar multimedia problem-based approach will enable caregivers to make better decisions about how to treat their patients and hopefully reduce overall costs.

Luke Sato, MD is an HMS instructor in radiology and associate director of the Innovation Center for Information Technology at the Decision Systems Group, Brigham and Women's Hospital.

Slight in Hand

The latest advancement in medical education at Harvard fits in the palm of your hand. Well, it actually takes two palms to hold it up, and those palms, right now, are only on the hands of the second- and third-year students.

In the spring of last year, Hewlett Packard, under its university grants program, gave the medical school 460 HP200LX computers, affectionately called "palmtops." The school then made them available to second- and third-year students—if they chose to take them—for a trial run; 75 percent of the third-years and 100 percent of the second-years signed up. While several students warily opened their boxes and skeptically filed their individual registration numbers with staff from the Office of Educational Computing (OEC), an intrepid few began digitizing everything from their personal address books and financial affairs to molecular biology facts and patient information.

"Resources that students used to carry around with them are now available on the palmtop," says Dale Curtis, educational computing coordinator, who brought the palmtop to HMS after having managed a successful palmtop program at the University of Arizona College of Medicine.

David Tom Cooke and Liane Clamen

photo by Liza Green

The palmtop measures 6.3 x 3.4 x 1 inches and weighs 11 oz. It looks like a digital personal organizer, it has the same uniform gray casing, but it's a little wider. (One student wrote in an evaulation of the palmtop that the bulkiness of it in the back pocket of his scrubs took a little getting used to.) The palmtop is powered by two AA batteries—what it takes to run a small flashlight—and a watch battery serves as backup. A DOS-based machine, it comes with two megabytes of built-in memory. Each student is given a ten-megabyte "flash" card, which acts like a disk, and compression software that doubles the capacity of the card, effectively providing an extra ten megabytes of memory. Retail, the HP200LX sells for $699, and the extra memory card is $600. Hewlett Packard donated $600,000 worth of equipment to the school.

The palmtop also comes with a few built-in software programs, including an appointment calendar, address book, memo pad, a version of the Lotus spreadsheet and Quicken, the financial planning program—an especially crucial tool for students on tight budgets.

But that's all basic fare. What comes next separates the HP200LX from that little electronic calendar-calculator mom or dad got for Christmas: it's chock full of medical information, from descriptions of all the basic disease entities to the vital statistics of the patients who have them. Students were given a software package for *Outlines in Clinical Medicine*, an electronic simulacrum of the *Washington's Manual*, which, for many, has usurped the bulkier book that was a staple for generations of anxious medical students. Acquiring other databases is in the works, including commercial ones for drugs, for example, and new ones continue to be developed.

"It makes the retrieval of information more efficient," says Carl Marci '97, one of the palmtop's biggest proponents. "In medicine, that's the name of the game."

Marci early on began developing databases and templates for use on the palmtop. He's created separate databases to record patient information upon admissions, and on rounds. The latter is especially efficient since students are required

to keep detailed daily records of each patient they see. Typically, students carry around a thick stack of 3" x 5" index cards in their pockets; each day, each patient gets a new card with all of his or her medical information carefully copied from the day before. With Marci's palmtop template, the first day's information is copied with the press of a couple buttons onto the next day, and then only the new or changed information needs entering.

Marci and classmate Sam Somers formed a core group of students to share information and to develop programs that enable the palmtop to be used more efficiently. They are developing a page linked to the HMS home page that will describe all the new programs being created, which students will be able to download for their own use. The page will also provide general encouragement and instructions on using the palmtop.

A miniature modem enables students to interface with Countway and with the HMS e-mail server. (Eventually, students may even be able to log on to the computer systems in the different hospitals.) Thus, they can do a Medline search and check their e-mail from anyplace with a phone jack—the hospitals or at home. An infrared sensor on the side of the computer makes transferring files from one computer to the other a snap: just aim two spots together and zap. You can do it in the MEC, you can do it in Countway, you can do it on the shuttle, you can do it just about anywhere. The school also purchased innocuous-looking little black boxes equipped with the infrared readers. These boxes hook into laser printers and allow students to print files, by aiming infrared at infrared, right from their palmtops. Right now, there is one such reader in the MEC, which creates a long line of students, palmtops in hand, at deadline times.

The medical school has also installed infrared readers on printers in a few of the hospitals so students can easily print out their admission and progress notes. (This may partially explain rumors of a few residents' covetous reactions to the palmtops, including one who is purported to have banished their use when he—or she—is around.)

photo by Liza Green

Carlin Chi (left) and Myrtha Cesar open their palmtops.

Most of the reaction from residents and attendings, however, has been positive. In fact attending David Soybel, assistant professor of surgery at Brigham and Women's Hospital, even requires the palmtops in his surgery clerkship.

"I frankly think we're coming to the point that [the palmtops] are going to become indispensable," says Soybel, "whether we like it or not."

Not only is the palmtop having an impact on how students are able to organize medical information as they learn it—Marci's has helped him purge "all those little slips of paper that used to cover my desk and drive me nuts"—but, if things go the way Soybel would like, the palmtop will also have an impact on the way students are taught. Included in the palmtop's software is an evaluation form for each clerkship. Unlike the paper evaluations students fill out at the end of the clerkship, the palmtop allows them to evaluate their experiences at the end of each day. In the end, faculty expect these daily summaries will provide a more thorough account of students' clerkship experiences.

Soybel especially sees the potential of the palmtop's quick efficiency. "You can't have managed care without managed information," he says. "Students have to utilize these tools or they can't operate in a managed care environment."

How useful the palmtop turns out to be to medical education will be determined when the pilot phase of the project is over at the end of the year. Early results, however, indicate that the experience has been favorable enough that the medical school has applied for a second grant from HP to provide the palmtops to the classes that currently lack them.

Its usefulness to students like Marci, however, has already been confirmed. "I'll go into even more debt to buy one," he says. Many students may be doing the same thing because once they graduate, they have to give them back.

Terri L. Rutter

Brave New Interviewer

by Warner V. Slack

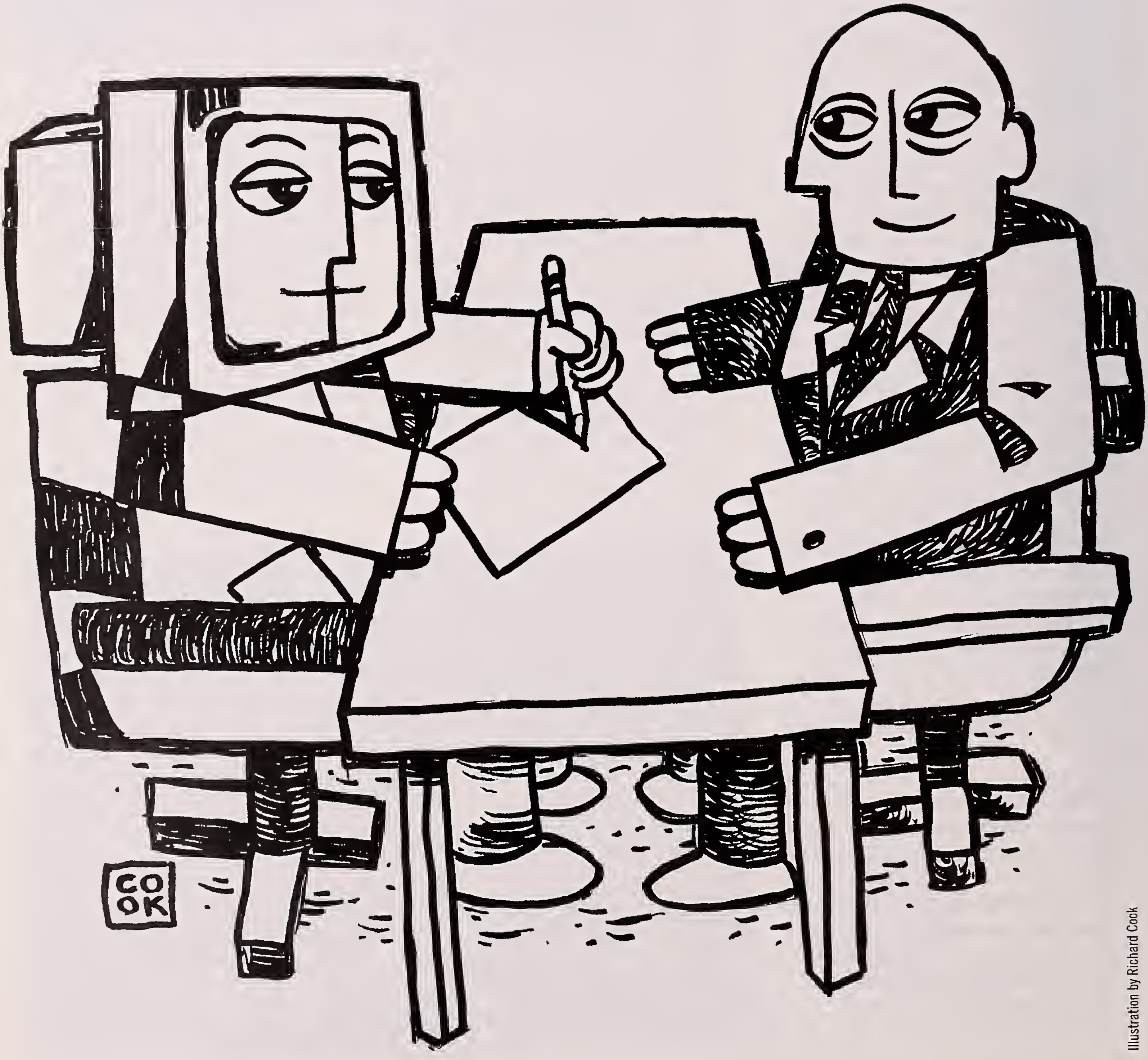


Illustration by Richard Cook

I HAD THE GOOD FORTUNE TO SPEND the decade of the 1960s at the University of Wisconsin in Madison, where a wonderfully radical atmosphere of strong social conscience and progressive ideology pervaded the campus. Remarkable science was being done there as well. Gobind Khorana was synthesizing a gene in a test tube, Howard Temin was postulating reverse transcriptase in RNA viruses, Milton Yatvin was lending new understanding to the hormonal control of genetic expression, Harry Harlow was elucidating the psychological bonds between mother and infant, and Carl Rogers, in a small, two-story cottage on University Avenue, was evolving his theory of nondirective psychotherapy.

It was in this environment, receptive as it was to ideas that departed from the traditional, that two lines of reasoning evolved and converged in my mind. The first line of reasoning led to the conclusion that the computer could be used wisely and well in the practice of medicine. The electronic digital computer, with its capacity to hold large amounts of data and to execute multiple complex instructions with great speed and accuracy would, I reasoned, find an important clinical role in both diagnosis and treatment. Investigators in a few institutions had begun to explore the use of the computer in diagnosis, but the computer in medicine under any circumstances was then a radical departure from tradition, and there were many voices of concern about dehumanization and the demise of the art of medicine.

The second line of reasoning led to a philosophy that I called "patient power" in the vernacular of the times, arguing that patients who want to should be encouraged to make their own clinical decisions and helped to do so. For centuries, the medical profession had perpetrated paternalism as an essential component of medical care, thereby depriving patients of the self-esteem that comes from self-reliance. The assumption was that the doctor knew best. Patient power questioned this assumption.

Like the idea of computers, the idea of patient power was highly controversial for its time, and the debate was frequently lively, among friends and enemies alike. In 1961, during a visit to our home in Madison, my brother Charles took me to meet Carl Rogers, who had introduced the concept of client-centered therapy to clinical psychology. This meeting was one of the turning points in my life. Rogers's support of patient power was the reinforcement I needed to persevere.

I put my ideas to the test in clinical practice at the University Hospitals in Madison, during neurology residency, and at Clark Air Base Hospital, during two years in the Philippines. I was convinced that with patients' input, medical records would be much improved. With the license to write behind a patient's back, as has been the tradition in Western medicine, factual errors that the patient could correct go uncorrected. Furthermore, there is a natural tendency to find fault with the patient when difficulties arise; diagnoses such as "inadequate personality" would have disappeared quickly if patients had seen them early.

Out of the Air Force and back in Madison, I continued to pursue my interest in clinical computing and patient power. Although my ultimate goals were to use the computer in diagnosis and treatment, it was clear that if the computer was to be of any help in medicine, good information—i.e., from the medical history, the physical examination, and the results of diagnostic studies—would have to be collected. My officemate, Philip Hicks, was working to automate the clinical laboratories; I decided to start with the medical history. In collaboration with Hicks, Lawrence Van Cura, and other colleagues, I hypothesized that we could program a computer to take a medical history directly from a patient.

The motivation came in part from a theoretical question: Could a computer model the physician? Could it actually interview a patient? There were also practical motives. For the busy clinician, particularly in areas of our country that are medically underserved, there is barely enough time to ask "Where does it hurt?," let alone all the other questions in the standard interview. In America, taking medical histories is a time-consuming and expensive process; talk is not cheap in medicine.

In the sixties self-administered paper questionnaires were being used with some success; the Cornell Medical Index and the "multiphasic" questionnaire of the Permanente Medical Group provided standardized, consistent, and inexpensive methods for taking medical histories. And many good self-administered questionnaires are used throughout the country today. Questionnaires, however, cannot be tailored to the individual situation because they don't permit interaction. They provide no mechanism to clarify the patient's meaning or to qualify answers about symptoms. If the patient answers "yes" to the question, "Have you ever coughed up blood?", this could mean a speck from the nose ten years ago or a massive hemoptysis last week. The patient may misunderstand a question (and thereby give an erroneous answer), inadvertently skip a question, or lose one or more pages of the questionnaire.

Our idea was to incorporate into the program at least some of the advantages of the physician as interviewer: the ability to explore abnormal findings in detail and to personalize the interview in an appropriate, dignified and considerate dialogue with the patient. At the same time, we wanted to gain the advantages of the questionnaire: its completeness, standardization and economy. We hoped that individual computer-based histories would be helpful to patients and their physicians; that the computer would be of interest to patients (perhaps even enjoyable); and that the pooled

responses to the interviews would help us learn more about the medical history and the process of clinical interviewing.

Some of our colleagues considered the idea radical. Those who questioned the use of computers in medicine were particularly concerned about the use of one to take a medical history. Some said it could not be done; others wondered if it should be done. Still others said that patients would find the idea offensive and would refuse to be interviewed by a computer, regardless of the nature of the program. (Years later, in completion of the critic's circle, they would ask, "Isn't everybody doing it?")

Patients, however, were remarkably enthusiastic. "It sounds like fun" and "I'd like to try my hand with a computer" were typical responses, particularly if (as was most often the case) they had never seen a computer. Their one concern was that the computer might try to do an "intelligence" test, which I assured them would not be done.

We decided to start with allergies for our first computer-based history. This seemed like a neutral, inoffensive subject for a computer; it is a field of great medical importance that relies heavily on the medical history, and our allergist consultant, Charles Reed, gave his enthusiastic support. We also mistakenly thought that an allergy history would be short. By the time we called a halt to expansion (Charles is very thorough) there were over 500 questions in the program.

Philip Hicks suggested that we use the LINC (laboratory instrument computer) for our study. This small, general-purpose digital computer was developed at the Massachusetts Institute of Technology in 1962 by Wesley Clark, Charles Molnar and their colleagues. It was a pioneering machine, and in many respects was the forerunner of today's personal computers. With it, the individual user could exert maximum control over the computer—a major departure from the batch-processing brontosaurs of the day. It was well suited for "on-line" collection (that is, collection of data directly by the computer) and "real-time" processing (processing data as fast as they are generated) of experimental data.

After a while it became clear that there was (I could think of no other word for it) rapport between man and machine.

Our plan was to program the LINC to communicate with the patient by means of questions, explanations, requests and comments displayed on the cathode-ray screen; the patient, in turn, could communicate with the computer by means of the typewriter keyboard. The LINC had a very small memory by today's standards—1,024 12-bit words—barely enough to hold the text for one question, together with the instructions in the program that told the computer what to do. (The off-the-shelf personal computer of today has about 4,000 times as much memory as the LINC.)

Two magnetic tape drives, which could turn equally well in either direction, provided additional storage space for text and instructions that were not in use, which could quickly be called into memory when needed.

We used one of the original LINCs, which had been brought to the University of Wisconsin's neurophysiology laboratory by Joseph Hind. The machine was in great demand, and programming time during the day was scarce; we did most of our work between 10:00 PM and 8:00 AM.

I approached one of our medical interns, who seemed amused by the idea of the computer-based history; he was sleep deprived, and the thought of being replaced by a computer, at least at night, had a distinct appeal. He suggested a patient who might be willing to help, an elderly man who was recovering from a heart attack and was now up and about, getting ready to go home. I went to his room, introduced myself and told him the general idea of the project. He replied that he would try anything once, and walked with me to the medical sciences building, where the LINC was housed.

The tapes churned and "HAVE YOU EVER HAD HIVES?" appeared on the screen. The characters flickered, the lights on the console flashed on and off, and the LINC's speaker emitted an eerie, high-pitched sound. On the other side of the sheetrock partition, people were walking in and out, and a cat that was part of a brain experiment was meowing. It was somewhat like Kafka's *Castle* or Koestler's *Darkness at Noon*. Clearly not optimal circumstances for a medical interview.

Yet my newfound friend seemed oblivious to his surroundings. He got going at the keyboard, responding to the questions, and after a while it became clear that there was (I could think of no other word for it) rapport between man and machine. He laughed out loud at some of the comments from the computer. (Some I had intended to be funny; some I hadn't.) And he talked out loud to the machine, sometimes in praise and sometimes in criticism.

"That was a dumb question," he noted with a chuckle. "You already asked me that!" He was right, of course, yet he never would have said this to me face to face, a doctor with a white coat and Bakelite nametag. At the conclusion of his interview, he turned to me and said, "You know, I really like your computer better than some of those doctors over in the hospital." Surprised, I asked him why.

"Well, for one thing, I'm sort of deaf and have trouble hearing them."

For each of the possible responses to the computer's questions, we had developed phrases that could be printed as a summary for the physician. When our first patient had completed his interview, I was relieved to hear the teletype chatter as it began to print; the summary program was working.

He then turned to me and said, "What's happening? May I read that?" I could not think of any reason why he shouldn't. Once again, the computer was helping him to assert himself as a patient.

As he started to read, he suddenly commented, in reference to some details about his hay fever: "No, that's wrong; I didn't mean that." He then proceeded to pick up a number of other errors. Clearly, there were mistakes in the interview. Yet if he hadn't asked to read his summary, I never would have known. Since that time we have asked our patients (whenever they are willing) to read their summaries and help us edit their medical histories and improve our computer-based interviews.

Encouraged by the results of this first interview, we did a more formal study. Fifty hospitalized patients volunteered to have their allergy histories taken. In each case, the results of the computer's history were compared with the allergy history as recorded in the hospital chart by the medical student, intern and resident attending the patient. None of the patients' charts mentioned an allergy that was not also described by the computer. For patients whose charts gave no indication of allergies, the computer elicited two cases of asthma, seven cases of hay fever, twelve cases of hives, and one case of allergy to penicillin.

In another case, the mention of "penicillin allergy" in the chart was insufficient to determine whether an allergy actually existed, whereas the computer described the single reaction in detail and left no doubt that a serum-sickness type of reaction had occurred. All drug reactions were described in more detail by the computer than by the students and physicians. On the other hand, the computer elicited and printed out some false positive information, such as an allergic reaction to phenobarbital that was later described by the patient as "excessive grogginess."

"You know, I really like your computer better than some of those doctors over in the hospital."

As we had hoped, almost all of the patients found their interaction with the computer both interesting and enjoyable. When asked to compare the computer with physicians in their experience, 20 patients had no preference, 12 indicated a preference for physician-taken histories and to our surprise, 18 indicated a preference for the computer-based system.

Heartened by these early results, we continued to study computer-based medical histories in our laboratories at the University of Wisconsin and, beginning in the early seventies, at the Beth Israel Hospital in Boston, when I joined Howard Bleich to form the Division of Clinical Computing in the Department of Medicine. We developed and studied a general review of systems (conducted in French and Spanish, as well as English) and histories for patients with problems such as uterine cancer, epilepsy and headache.

We also ventured into a field that was somewhat more controversial for the computer. We developed a psychiatric history, designed as a general review of behavioral problems, and gave it to 69 volunteers who had been scheduled for psychiatric evaluation. As with other computer histories, the patients reacted favorably and indicated a slight preference for the computer as interviewer over physicians.

A finding of great interest to us in those early days of patient/computer dialogue, one since corroborated by further study, was that patients often found themselves more comfortable communicating information to the computer about potentially embarrassing matters, such as sexual activity and emotional problems, than they would have been talking to their physicians. When we programmed a computer interview to facilitate soliloquy, we found that subjects, when encouraged by the computer, talked easily into a microphone, first about anxiety-provoking circumstances and then about relaxation. As an indication of the effectiveness of the program, both mean heart rate and "State anxiety" scores of 42 volunteers fell significantly between the beginning and the end of the interview.

In the meantime, others began to work actively in the field. A general medical history, with emphasis on the review of systems, was developed and studied at the Mayo Clinic, and both patients and physicians reacted favorably. Another general medical history was studied at the Massachusetts General Hospital, where patients reacted favorably. Physicians' attitudes were mixed, but the computer's summaries were in good agreement with the physicians' own findings. Meanwhile, other investigators were developing and evaluating histories in specialty areas, such as psychiatry and psychology, nutrition, headache, venereal disease and allergy. And the field of computer-based interviewing remains active.

Yet the idea of a computer taking a medical history can still evoke worrisome thoughts: *2001: A Space Odyssey* or *Terminal Man*, Orwellian thought control. But the experience of our first patient, and the majority of patients who have subsequently engaged in dia-

logue with computers, was the opposite of what some had predicted. This man had gained control, not lost it. For the first time in his role as a patient, he was in charge; he was master of his own history. And, in his world of deafness he could communicate particularly well with the machine.

In the spring of 1970, I presented my ideas on patient power and clinical computing to the "Second Conference on the Diagnostic Process," held at the University of Michigan in Ann Arbor. Those in attendance were divided in their reactions, and the ensuing debate was heated. The moderator, John Romano (chair of the Department of Psychiatry at the University of Rochester) staunchly defended the right of the physician to direct the patient ("patients want to be told what to do"); Leonard Savage (professor of statistics at Yale), on the other hand, said that he "was particularly pleased to hear the bold and radical defense of the thesis that medical values should be those of the patient."

The debate was to continue through the 1970s. Franz Ingelfinger, editor of *The New England Journal of Medicine*, rejected my article "The Patient's Right to Decide," making it clear that he strongly disagreed with my position. On the other hand, Ian Monroe, editor of the *Lancet* (and to whom I will be forever grateful), sent me an encouraging letter of acceptance and published my article forthwith. But all agreed during those decades of debate that when it came to dialogue between patient and computer, the patient should be in charge. Ironically, it would be easier to transfer control to the patient by means of an automaton than by means of the physician.

It is my premise that the largest yet least used health care resource, worldwide, is the patient or prospective patient and that the interactive computer can be used beneficially to enlighten patients and empower them in the health care process, thereby improving the quality of care while

Ironically, it would be easier to transfer control to the patient by means of an automaton than by means of the physician.

reducing the cost. There are a number of common important medical problems, such as sore throat and urinary tract infection, that patients could manage alone if they were provided with the clinical information necessary to do so.

Whether clinical management is primarily the responsibility of the clinician or the patient is often dictated by forces of supply and demand. If, for example, the biochemistry of insulin or the physiology of the pancreas were such that a child with juvenile diabetes needed only one insulin injection per year, it is likely that an academic endocrinologist in a teaching hospital would give the injection, but at considerable expense. If the child needed an injection every six months, the pediatric diabetologist would give it; if every three months, the primary care physician; and if once a month, the nurse practitioner. But since the child needs the insulin at least once a day, the parent or child is responsible for administering the injection, without assistance. And the parent or child usually does this skillfully, conveniently and at low cost.

In our laboratory in the Center for Clinical Computing, at Harvard Medical School and Boston's Beth Israel Hospital, Hollis Kowaloff, Doug Porter, our colleagues, and I have studied the interactive computer as a patient's assistant in a variety of other health-related areas. In nutrition, in collaboration with Jelia Witschi, we developed a three-part dietary counseling interview, which asks questions dealing with general dietary behavior, elicits details of food intake on an average day, and plans with the patient a weight-reducing diet of approximately 1500 kcal. During the interview, the program offers dietary suggestions and, on completion, generates a printed summary for use by patients and nutritionists.

We have also developed and studied a program designed to assist women in caring for uncomplicated urinary tract infection. The program takes a history of the present illness (e.g., "Are you bothered by pain or burning when you urinate?"), performs a review of systems, interprets laboratory data, suggests referral when additional medical problems are indicated, tests the reliability of important questions by repeating them, resolves uncertainties that the patient may have (e.g., when the patient does not understand a question), advises about diagnosis and treatment, explains the therapeutic options in the order of importance to the patient, offers opportunities to review information previously presented, offers the opportunity to decide about therapy (e.g., whether to start with sulfa immediately, consider another treatment, or wait until the results of the urine culture are available), writes a prescription, prints a progress note for the chart and reminders for the patient, schedules follow-up visits, conducts follow-up interviews, and helps to guide the progress of therapy.

In collaboration with clinicians at Beth Israel Hospital, together with members of the employee health department, we also developed a computer-based health screening interview for hospital employees. The interview is part of the clinical information system, developed by the Center for Clinical Computing and used throughout the hospital, and is available on

any of over 3,000 terminals. Conducted in private and with protection of confidentiality, the interview seeks information on medical problems and patterns of living for which behavioral change is considered desirable and offers advice and suggestions on matters of health and illness (general medical history, nutrition history, exercise patterns, habits, safety, environment and stress). At the end of the interview the program offers a clinical evaluation of problems that could be favorably influenced by changes in behavior. In addition, en route through the interview, the program offers information about referral services.

In a 5.5-year period ending in November 1995, 2,586 employees completed the interview. Eighty-five percent of the employees expressed an interest in the health-related programs offered by the hospital: 73 percent were interested in the fitness center and 38 percent in the stress-reduction program. The results showed that stress and unhappiness were common: 57 percent of the employees reported high levels of stress and 43 percent reported feeling sad, discouraged or hopeless in the previous month; 6 percent indicated that life sometimes did not seem worth living. (As soon as their responses were registered, these people were told by the computer where they could obtain help for their problems.)

Over the years, we have incorporated into our programs a number of provisions designed to yield control to the patient in dialogue with the computer. With the typical interview, we request permission to proceed (e.g., "May we call you by your first name?" and "Would it be OK with you if we asked a few questions about your emotions?") and do our best to respect the patient's priorities, their right to decide (with sufficient alternatives), their right not to decide, to help with uncertainty (offering "don't know" and "don't understand" options, with explanations when appropriate), and to respect a reluctance to respond.

In Wisconsin, we incorporated a "none of your damn business" option into responses to the questions. We have since toned it down to "skip it," better accepted in Boston. An expanded set of responses to yes/no type questions enables patients to indicate uncertainty and lack of comprehension, to request clarification, and to bypass questions they don't care to answer. This reduces the number of uninformed responses and the coercion that can lead to inconsistency, subterfuge, and decreased validity. Most of our computer-based interviews also employ, to some extent, other mutually exclusive numbered choices, multiple choices with more than one response acceptable, and free-text responses.

I used to dream of an interactive Dr. Spock, a computer-based program available to the parents of a sick child, that would offer advice about diagnosis and treatment and when to seek further medical help. (When to go to the doctor is sometimes the most difficult of diagnostic decisions.) With the burgeoning technology of worldwide communication, this dream can now be a reality. Medically useful dialogue can be made available on any personal computer, in addition to computers in physicians' offices, clinics and hospitals.

In our experience, concern about the computer as a depersonalizing influence in dialogue with patients has been unfounded. Computer interaction thus far has been pleasant, interesting, informative and empowering for most patients, and has been effective in helping them to help both themselves and their doctors.

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photo by Stuart Darsch

The Senior Set on the Net

by George S. Richardson

In theory, the Internet should be a boon to disabled elderly shut-ins, yes, even the "old old." What could be better for the housebound, the bedridden, to soar off into cyberspace or to find themselves in a delightful romper room full of people who share their pains, joys and memories. If only it could be as easy as tapping just one red button on a keyboard!

In actuality, as we all know, there is a great gulf fixed between the young, who are users, and the old, who are not. This, I believe, is not simply due to a lack of energy and of coping skills on the part of us elders—although my son claims that no one over 40 can cope with a VCR. (He forgets that the directions for ours were lost long ago, when he gave us the machine.)

"Coping skills" is worth a parenthetical comment. As doctors, we know that the physical problems of the elderly are not entirely unlike those of younger persons with disabilities. For every disability another coping skill is required. As a result, the elderly must accumulate a host of coping skills that healthy younger persons never think about. In this sense the elderly may properly be called the "mature!"

Another fact of accumulated years and accumulated skills is that each new experience or challenge is a smaller fraction of the total. A new learning challenge is bound to make less of an impression than it would have in the past, so that it takes a little more time and care to learn new skills than it did when we were young. It was not unusual, I think, that my brother, E.P. Richardson '43A, and I could learn to touch-type by computerized instruction when we over 65, although neither of us had ever typed before.

Whatever the problems of the elderly, we are not naive; we already have our interests. Most of us have the skills we need to pursue them—print resources in the form of magazines, books, references and encyclopedias, many already on our shelves. Many of us have the skills to seek further in libraries and in their catalogues, computerized or otherwise, and we get a solid sense of comfort in doing so. Having been chairman of the MGH library committee for many years, I enjoy the help of their reference librarians, as well as on-line access from my home to the catalogues of the Harvard libraries and Countway (through HOLLIS), the Boston Library Consortium, and the Library of Congress, as well as access to the medical literature through Ovid technologies.

Does this mean that we don't need the information highway? Indeed, those of us who have tried venturing into cyberspace have found that the "highway" is fenced in by huge garish billboards on all sides and this "information" is mostly advertising. When it is not, it seems like a child's gee-whiz encyclopedia. The more user-friendly the server, whether it be CompuServe, Netscape, America Online or any of their many ancestors and descendants, the more this seems to be true.

But if we're not in the market for information, as such, we may be in the market for something else. Someone out there in the entrepreneurial world has failed to tell us what it is—surprising, in view of the fact that we are the fastest-growing fraction of the U.S. population.

I, for one, could be sold on: (1) being able on any day, at any hour, to tour the world, seeing its natural wonders, its animals, its cities, and visiting the universities and museums that we would visit on an actual tour; and (2) being able to find, on any day, at any hour, a group of people, gathered from anywhere in the world, who share some special little interest of mine. And, of course, I want these features to be (3) very user-friendly.

America Online includes SeniorNet, "a national nonprofit organization whose mission is to build a community of computer-using seniors....SeniorNet currently has over 18,000 members [pretty small, huh?] and has helped start 75 Learning Centers around the United States where computer classes specifically designed for older adults are offered."

Under this rubric, SeniorSite includes a host of subjects from government resources to "older jokes for older folks." The Senior Citizens Opinion Forum seeks to remedy the observation that AARP publications do not provide much space for letters and

opinions. The forum solicits articles of 250 to 650 words on issues affecting the elderly. In addition, SeniorNet Online Electronic Community provides discussion groups on a variety of topics (genealogy, pets, sex and much, much more).

The World Wide Web has everything, including topics of especial interest to older people. For example, the home page of Michael Notte, an expansive Italo-Canadian, (http://www.niagara.com/~jmnotte), is interesting and informative, and it provides gateways to a lot of elder-oriented material. Once on the Web, you can slum around in the Louvre (full coffee-table quality reproductions on screen!) or any of a vast number of sites, including MGH's Department of Neurology (a real funny guy lurks behind it).

Back to the romper room. America Online provides user-friendly access with their "chat rooms" beginning with the New Member Lounge and on through "private rooms." Access to the latter is restricted to those who know its name, which might be "Harvard Medical Alumni," for example. (No, it does not exist yet, so far as I know.) A room "holds" about 25 people. After that, mitosis occurs and a new room is formed. In these rooms, participants can choose any screen name they wish, and enter by saying, "Hi, everyone" or whatever and leave with a "Bye" whenever they choose. "Screen name" also means an identity that may be false, so that a person who ought to be called "Grumpy Grampa" can enter as "Cute Chick."

(The whole topic of surfing in cyberspace with fictional identities has received serious treatment in a fascinating book, *Life on the Screen: Identity in the Age of the Internet*, by Sherry Turkle, Simon & Schuster, 1995.)

America Online is about as user-friendly as you can get, but its friendliness comes with limitations. E-mail is slower, access to cyberspace is limited and, at times, lines are loaded and access is impossible. That single, red button that accesses the romper room still eludes us. (Wouldn't it also be nice for those of us with memory problems to have other color-coded buttons: a purple button to get the list of children and grandchildren with their birthdays, green for fellow members of a committee, yellow for HMS classmates.)

Meanwhile, however, this alum urges HMS to set up a clubroom out there with scheduled meetings once a week so that those of us with modems can dial in, make friendly or vituperative remarks, as the case may be, and educate the dean. In order to control the size of the room, we could even be divided into (yuck!) "pentads."

In addition, and in all seriousness, this step could prove to be a life-saver. Listeners to National Public Radio may recall an incident that occurred last spring. Elderly women who were members of an Internet club that met regularly in cyberspace noted one day that a regular member had failed to check in. None of them knew her in any way except through text on their computer screens. Nevertheless, they went to work, found her home address and sent police to check. The woman had had a stroke, and was taken at once to the hospital.

As I go through the notes that my classmates have sent in for our 50th reunion booklet, I find that fewer than 10 percent record an e-mail address. Just think, if we all had e-mail addresses, we could be a great interactive alumni association and other, lesser organizations would be left in the dust, where they belong.

Yours to a green old age!

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